

# CONTENTS

## FOREWORD

## ORGANIZING COMMITTEES

### 1 Transmission Lines

<b>95 IPST 130-08</b> Analysis of electromagnetic transients in cross-bonded cable systems using frequency dependent cable models	5
L. Martí, R. H. Brierley, T. E. Grainger (Canada)	
<b>95 IPST 095-08</b> A simple and efficient method for including frequency-dependent effect in a transmission line transient analysis	11
A. Ametani, N. Nagaoka, T. Noda, T. Matsuura (Japan)	
<b>95 IPST 132-08</b> Phase-domain multiphase transmission line models	17
F. Castellanos, J. R. Martí (Canada)	
<b>95 IPST 013-09</b> Interfacing with EMTP a general-purpose transmission line model	23
M. T. Correia de Barros, M. E. Almeida, L. Dubé, B. Stein (Portugal)	
<b>95 IPST 141-09</b> A comparison of frequency-dependent line models in connection with implicit segmentation schemes	29
H. M. Barros, R. M. Azevedo, S. Carneiro Jr. (Brazil)	
<b>95 IPST 092-09</b> An efficient method to deal with boundary conditions in an electromagnetic transient analysis	35
A. Ametani (Japan)	
<b>95 IPST 057-16</b> Modelling with EMTP of overhead lines illuminated by an external electromagnetic field	39
A. Xémard, Ph. Baraton, F. Boutet (France)	
<b>95 IPST 140-16</b> An EMTP-compatible procedure for the evaluation of electromagnetic induced effects on power networks	45
M. D'Amore, M. S. Sarto (Italy)	
<b>95 IPST 050-16</b> Reference circuits for the investigation of power systems transients	51
G. Ban, L. Prikler (Hungary)	
<b>95 IPST 024-16</b> Modelling the transient behaviour of a large superconducting coil subjected to high voltage pulses	57
A. M. Miri, C. Sihler, M. Droll, A. Ulbricht (Germany)	

## 2 Cables, GIS

<b>95 IPST 117-19</b> Tucurui's 500 kV SF <sub>6</sub> gas-insulated substation fast transients - Analysis, modeling and field test comparisons	65
J. F. de Lima Filho, F. A. F. Pazo Blanco, A. D'Ajuz, L. F. A. Nascimento (Brazil)	
<b>95 IPST 023-19</b> Investigation of transient phenomena in inner- and outer systems of GIS due to disconnecter operation	71
Amir M. Miri, C. Binder (Germany)	
<b>95 IPST 070-19</b> VFT-characteristics of shielding cylinders in power transformers	77
K. Rechberger, S. Pack (Austria)	
<b>95 IPST 135-22</b> Field measurements and modelling of the transients propagation properties of a 380-kV cable system of 7.5 km length at BEWAG, Berlin	82
M. Ermel, J. Pannicke, M. Henschel (Germany)	
<b>95 IPST 093-22</b> Sheath overvoltages due to faults on an EHV cable	87
A. Ametani, C. T. Wan (Japan)	
<b>95 IPST 077-22</b> An abnormal overvoltage due to load rejection on EHV underground transmission lines	93
Takashi Karasaki, Takeshi Goto, A. Ametani (Japan)	

## 3 Transformers, reactors

<b>95 IPST 039-10</b> A new EMTP transformer model based on modal analysis	101
D. J. Wilcox, D. J. Leonard (Ireland)	
<b>95 IPST 036-10</b> An improved transformer model for transfer voltage study	107
Toshiaki Ueda, Sadanori Neo, T. Sugimoto, T. Funabashi, N. Takeuchi (Japan)	
<b>95 IPST 026-10</b> Geometrical transformer model including hysteresis	113
J. M. Prousalidis, N. D. Hatziargyriou, B. C. Papadias (Greece)	
<b>95 IPST 022-15</b> Methods for considering the eddy current losses in the detailed model of a HV-transformer	119
Amir M. Miri, M. A. Nothaft, P. Braess (Germany)	
<b>95 IPST 054-15</b> Transformer core modelling	125
Washington L. A. Neves, Hermann W. Dommel (Brazil)	
<b>95 IPST 076-15</b> Basis of an algorithm for accurate calculation of transient ferromagnetic hysteresis	131
Jean Riubrugent, Raul Bianchi Lastra, Maria B. Barbieri, Julieta Vernieri (Argentina)	
<b>95 IPST 109-15</b> A power transformer model for investigation of protection schemes	136
Bogdan Kasztenny, E. Rosolowski, Murari Mohan Saha, B. Hillström (Sweden)	

<b>95 IPST 040-18</b> Inrush currents of three-winding transformers Minna Laasonen, Ritva Hirvonen (Finland)	142
<b>95 IPST 041-18</b> Influence of random variables on transformer inrush current L. Pierrat, T. Tran-Quoc (France)	148
<b>95 IPST 029-18</b> Analysis of power transformer matrix representation in electromagnetic transient studies G. Calzolari, C. Saldaña (Uruguay)	153
<b>4 Switching surges, capacitors</b>	
<b>95 IPST 056-02</b> Overvoltage and overcurrent during non-simultaneous faults in transmission lines Pawel Sowa (Poland)	161
<b>95 IPST 009-02</b> Single phase reclosing in UHV long lines for Amazon transmission system Luiz Cera Zanetta Jr., Paulo César Esmeraldo, Luiz Sebastião Costa (Brazil)	167
<b>95 IPST 075-02</b> Comparative research into switching overvoltages in the case of switching by SF <sub>6</sub> circuit breaker in the 400 kV network of Croatia Strecko Bojic, Ante Sekso, Ivo Uglesic (Croatia)	173
<b>95 IPST 049-02</b> EMTP models for simulation of shunt reactor switching transients L. Prikler, G. Ban, G. Banfal (Hungary)	178
<b>95 IPST 020-05</b> Measurements and modelling of capacitor connecting transients on a low-voltage grid equipped with two wind turbines Ake Larsson, Torbjörn Thiringer (Sweden)	184
<b>95 IPST 124-05</b> Technologies for transient voltage control during switching of transmission and distribution capacitor banks Thomas E. Grebe (U.S.A.)	189
<b>95 IPST 074-05</b> Evaluation of switching concerns related to shunt capacitor bank installations R. Shivakumar Aradhya, Sujatha Subhash, Meera K. S. (India)	195
<b>5 Generators, machines</b>	
<b>95 IPST 136-21</b> On the comparison between a detailed turbine-generator EMTP simulation and corresponding field test results Bahram Khodabakhchian, Gia T. Vuong, Sylvain Bastien (Canada)	203
<b>95 IPST 144-21</b> Modeling effects on transient behavior of synchronous machines Sebastião E.M. de Oliveira (Brazil)	209

<b>95 IPST 037-21</b> Correct and fast network simulation using the new calculation method SDLV3 with advancing implied Euler step	215
U. Linnert (Germany)	
<b>95 IPST 005-23</b> Turbine-generator set transients caused by unbalanced short circuits	221
Zlatko Maljkovic, Ljiljana Kuterovac (Croatia)	
<b>95 IPST 082-23</b> The study of torsional impact on turbine-generator shaft using EMTP and supplementary programs	227
Yongzhuang Li (China)	
<b>95 IPST 089-23</b> Influence of neutralizer on ground fault overvoltages in generator stator windings	233
M. Zielichowski, M. Fulczyk (Poland)	
<b>95 IPST 129-23</b> Simulation of switched reluctance motor back-EMF compensation	239
E. Bassiliy, G. A. Capolino, H. Henao, M. Poloujadoff (France)	
<b>95 IPST 032-26</b> Including a wind energy conversion system model in electromagnetic transients program	243
Francisco A. G. S. Reis, Rui M. G. Castro, Ana I. L. Estanqueiro, J. M. Ferreira de Jesus (Portugal)	
<b>95 IPST 139-26</b> Modelling utility connected dispersed generation on an electromagnetic transients program	249
D. M. Gilbert, I. F. Morrison (Australia)	
<b>95 IPST 058-26</b> Operation of a single phase opening/closing cycle on an hydroelectric motor-pump: a numerical simulation approach	255
A. C. Ammari, L. Pierrat (France)	

## 6 Protection, faults

<b>95 IPST 091-04</b> MORGAT for testing MV and EHV protective relays	261
A. Montmeat, A. Giard (France)	
<b>95 IPST 015-04</b> Digital distance protection algorithm with self-adapting features and network communication	266
Erhard Wittmann, Christian Hendrich (Germany)	
<b>95 IPST 017-04</b> Using the EMTP and the Omicron to design a transients based digital ground-fault relay for isolated or compensated networks	270
John Coemans, J.-C. Maun (Belgium)	
<b>95 IPST 101-04</b> Tripping analysis of generator negative sequence relay during a transformer energization	276
Mauro Fissassi Ushikubo, Arlei Bichels (Brazil)	

<b>95 IPST 122-07</b> Simulation of industrial decoupling devices	282
E. Lerch, P. Zaherdoust, G. Bizjak (Germany)	
<b>95 IPST 138-07</b> A statistical method for the detection of power system faults	288
D. M. Gilbert, I. F. Morrison (Australia)	
<b>95 IPST 113-07</b> Differential diagnosis of faults and the sequential switching command of circuit breakers considering the current displacement phenomenon	294
Fl. Munteanu, D-tru Ivas, G. C. Paap (Romania)	
<b>7 Lightning, arresters</b>	
<b>95 IPST 055-14</b> Calculation of lightning overvoltages using EMTP	301
Thor Henriksen (Norway)	
<b>95 IPST 004-14</b> Influence of corona on lightning-induced voltages on overhead power lines	306
C. A. Nucci, S. Guerrieri, M. T. Correira de Barros, F. Rachidi (Italy)	
<b>95 IPST 060-14</b> Calculation of voltages induced by nearby lightning on overhead lines terminated on distribution transformers	311
A. Borghetti, R. Iorio, C. A. Nucci, P. Pelacchi (Italy)	
<b>95 IPST 051-14</b> Investigation of distribution transformer overvoltage protection by computer simulation	317
A. Somogyi, L. Vizi, G. Ban (Hungary)	
<b>95 IPST 014-17</b> Statistical study of the lightning overvoltages at a gas insulated station transformer	322
M. Fernandes, M. T. Correia de Barros, M. E. Almeida (Portugal)	
<b>95 IPST 035-17</b> Flashover model for arcing horns and transmission line arresters	328
Toshiaki Ueda	
Sadanori Neo, Toshihisa Funabashi, Toyohisa Hagiwara, Hideto Watanabe (Japan)	
<b>95 IPST 062-17</b> Dimensioning of tell-tale spark gaps for valve arresters in HVDC converter stations	334
Kadry Sadek, Peter Luetzelberger, Markus Haeusler (Germany)	
<b>95 IPST 097-17</b> An approach to metal oxide arresters switching surges energy absorption capability evaluation	339
Manuel Luis Barreira Martinez, Luiz Cera Zanetta Junior (Brazil)	
<b>8 Transmission and distribution</b>	
<b>95 IPST 071-13</b> Transient behaviour of an urban medium voltage cable network	347
Stephan Pack, Markus D. Seiser (Austria)	

<b>95 IPST 107-13</b> The use of the computer program ATP for studying electrical transients in industrial power systems	353
Luiz Alberto Fernandes Valle (Brazil)	
<b>95 IPST 044-13</b> An equivalent circuit for earth-fault transient analysis in resonant-grounded distribution power networks	359
P. Ferracci, M. Meunier, L. Berthet (France)	
<b>95 IPST 118-25</b> Analysis of overvoltage control on half wave length Amazon transmission system	365
A. G. Massaud, J. C. S. Salomão, R. Vaisman, M. Cordeiro, M. P. Meirelles (Brazil)	
<b>95 IPST 025-25</b> Application of saturated reactors on power transmission systems	371
Dalton O. Campones do Brasil, Manoel Afonso de Carvalho Jr. (Brazil)	
<b>95 IPST 112-25</b> Modeling Mead-Phoenix 500 kV phase shifting transformer in EMTP studies	377
R. S. Thallam, D. W. Gerlach, T. G. Lundquist, S. R. Atmuri (U.S.A.)	
<b>95 IPST 110-25</b> Comparison of active and reactive power control for improvement of power system stability	382
R. Dilger, D. Nelles (Germany)	

## 9 Control and operation

<b>95 IPST 053-03</b> Modelling of digital HVDC control systems using a graphical electromagnetic simulation program	391
K. Sadek, G. Wild, L. Hügelschäfer, A. Gole, X. Jiang, D. Brandt (Canada)	
<b>95 IPST 119-03</b> Efficient computer simulation of STATCON	397
Dusan Povh, M. Weinhold, Igor Papic (Germany)	
<b>95 IPST 123-03</b> Modeling an active power line conditioner for compensation of switching transients	403
Le Tang, Mark F. McGranaghan (U.S.A.)	
<b>95 IPST 085-03</b> Transient overvoltage and overcurrent studies using EMTP to evaluate the feasibility of simultaneous energization of TSC and filters of FURNAS SVC located in Bandeirantes - A comparison and validation of digital transient simulations by means of site measurements	409
Cezar Ribeiro Zani, Paulo Cesar Fernandez (Brazil)	
<b>95 IPST 100-06</b> Development of large-capacity multi-phase rectifier model for industrial use by utilizing EMTP	415
Hiroyuki Iki (Japan)	
<b>95 IPST 083-06</b> A simulation of a harmonic current in a building distribution system	421
N. Nagaoka, S. Ishida, A. Ametani, H. Imai (Japan)	

<b>95 IPST 063-06</b> Comparison between calculation of zero-sequence harmonic currents generated in HVDC converter stations	427
Kadry Sadek, Peter Luetzelberger, Lutz Kirschner (Germany)	
<b>95 IPST 064-11</b> Designing controls for non-linear systems with electromagnetic transient programs	431
G. D. Irwin, O. B. Nayak, A. Neufeld, D. A. Woodford, A. M. Gole (Canada)	
<b>95 IPST 120-11</b> Global parameter settings of FACTS-controllers for improving power system stability	436
Xianzhang Lei, Dusan Povh, Edwin Lerch (Germany)	
<b>95 IPST 142-11</b> Models of a distribution static condenser (STATCON) for EMTP	442
R. Kagalwala, S. S. Venkata, P. O. Lauritzen, A. Sundaram, R. Adapa, V. V. Sastry (U.S.A.)	

## 10 Ground and arc phenomena

<b>95 IPST 048-24</b> Aspects concerning the analysis of grounding systems' transient behaviour using EMTP	451
Radu Popa, Ileana Baran, Jacques Trecat (Belgium)	
<b>95 IPST 042-24</b> Measurements of a concrete pole impedance with an impulse current source	457
S. Sekioka, K. Yamamoto, S. Yokoyama (Japan)	
<b>95 IPST 043-24</b> Development of a nonlinear model of a concrete pole grounding resistance	463
S. Sekioka, T. Hara, A. Ametani (Japan)	
<b>95 IPST 145-24</b> Effects of tower grounding system models on insulation coordination of overhead transmission lines	469
A. P. Sakis Meliopoulos, William Adams, Robert Casey (U.S.A.)	
<b>95 IPST 012-27</b> Fault arc modeling in EMTP	475
J. Sousa, D. Santos, M. T. Correira de Barros (Portugal)	
<b>95 IPST 125-27</b> Modelling of semiconductor fuses in EMTP	481
X. Z. Meng, J. G. J. Sloot, H. Rijanto (Netherlands)	
<b>95 IPST 126-27</b> Comparison of different models for superconducting fault current limiters	487
M. Noe, B. R. Oswald (Germany)	

## 11 Solution algorithms

<b>95 IPST 103-01</b> The design of time-domain simulation tools: the computational engine approach	493
Jean Mahserejian, Fernando Alvarado (Canada)	

<b>95 IPST 068-01</b> The implementation and effectiveness of linear interpolation within digital simulation	499
Peter Kuffel, Kelvin Kent, Garth Irwin (Canada)	
<b>95 IPST 099-01</b> Advanced representation of power semiconductors using the EMTP	505
J. A. Martinez-Velasco, R. Abdo, G. A. Capolino (Spain)	
<b>95 IPST 143-12</b> Modeling of power electronics devices in EMTP-TACS	511
Serge Lefebvre, Ricardo D. Rangel (Canada)	
<b>95 IPST 018-12</b> Performance assessment using EMTP of two gate firing units for HVDC converters operating with weak ac systems	517
V. K. Sood, V. K. Khatri, H. Jin (Canada)	
<b>95 IPST 001-12</b> Effect of unbalances in ac power systems on dc machines control system	523
João R. Cogo, Jocélio S. de Sá, Valberto F. da Silva (Brazil)	
<b>95 IPST 121-20</b> Advanced stability program for the simulation of HVDC in large power systems	529
D. Povh, J. Rittiger, B. Kulicke, D. Clodius (Germany)	
<b>95 IPST 105-20</b> A new hybrid ac-dc transient stability program	535
G. W. J. Anderson, C. P. Arnold, N. R. Watson, J. Arillaga (New Zealand)	
<b>95 IPST 133-20</b> Sub-area latency in a real-time power network simulator	541
Luis Linares, José R. Martí (Canada)	
<b>95 IPST 046-28</b> Aggregated model of distribution power networks during transients	546
I. Mocanu, M. Meunier, P. Lasbleiz, A. Giard (France)	
<b>95 IPST 045-28</b> Transients analysis in resonant grounded power distribution systems	552
Oinis Chaari, Patrick Bastard, Michel Meunier, Françoise Brouaye (France)	
<b>95 IPST 028-28</b> Generalized compensation method for nonlinear inductances and resistances representation in electromagnetic transients studies	558
G. Calzolari, C. Saldaña (Uruguay)	