### Provisional Technical Programme

See the list of Accepted Paper Proposals based on synopses review.

Kindly note that Full Papers are also peer-reviewed. Therefore, the list may evolve.

Final notification to authors is planned on 6th May 2024.

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The benefits of nuclear turbogenerators for grids of the future
Herve BIETTLMANN1, Florent CHARVET1, Jacques MARCHAND1, Martin TOULEMONDE1, Stephane BRAEM2, Vincent DUBS2, Baptiste GUIDOUX2, Vincent FERNAGUT2, Thierry VINAS2
1General Electric, France; 2EDF, France

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A1 POWER GENERATION AND ELECTROMECANICAL ENERGY CONVERSION - Full Papers
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Thomas HILDINGER
Brazilian NC of CIGRE, Brazil; Voith Hydro

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Hans BARNKL1, Lena M. ELSPASS2, Stephan SCHLEGEL1, Kai NEIKES2, Jens PROSKE2
1Technische Universität Dresden, Germany; 2VEM Sachsenwerk GmbH, Germany

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Design individualization of an air-cooled synchronous condenser with directly water-cooled stator winding due to varying market requirements for grid stabilization services
Monja EVENKAMP, Hendrik STEINS, Uwe EICKELBECK, Moritz ACKERMANN
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Oleg AGAMALOV
Tashlyk Pump-Storage Power Plant (TPSPP)

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PS2 - EVOLUTION AND DEVELOPMENT

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Marc FLORES, Luc TEMPLIER, Léo PERDRIEL
EDF Hydro DTG, France

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Damping local and inter-area oscillations with synchronous compensators: a fundamental study
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Jorge Johnny ROCHA ECHEVERRIA, Mauro UEMORI
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Akira BANDO1, Toshinari FUJII2, Shinji ONO2, Osamu NAGURA1, Masayuki OKADA1, Tomohiro YANO3
1HM Hydro Corp., Japan; 2Kansai Electric Power Co., Japan; 3Hitachi, Ltd., Japan

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Voith Hydro, Germany
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Thomas HILDINGER¹, Christian STAUBACH²
¹Voith Hydro, Germany; ²Hochschule Hannover, Germany

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Gerfried MAIER, Serdar KADAM
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Sándor Rajmund HORVÁTH
HD Hyundai Electric Hungary Ltd.

Fatigue breaking mechanism study at the coils connections of a stator winding and at the magnetic core fasteners
Aymen AMMAR¹, Thibaud FANGET², Romain SEIGNEURET²
¹JEUMONT ELECTRIC, France; ²EDF (DTG CNEPE), France

Use of Non-Destructive Tests (NDT) for synchronous condensers flywheel inspection
Gianluigi GEMELLI
TERNA, ITALY

Detection of Generator Earth-brush Fault Types from Shaft Voltage and Currents Measurements to monitor the performance of Earthing Brushes
Oupa MAILULA
Eskom Research, Testing & Development

Deep learning applied to bearing anomaly detection using advanced signal processing techniques
Marcos NISHIOKA, Gustavo G. de SOUZA, Tiago MATSUO, Emerson LIMA DO NASCIMENTO, Vitor POHLENZ
Brazilian NC of CIGRE, Brazil; AQTECH
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**Reconfiguration of the Corona Prevention System and Application to a Practical Case**

Paulo VILHENA¹, Renan DUARTE¹, Fernando BRASIL¹, Jorge Johnny ROCHA ECHEVERRIA², Mauro UEMORI²

¹Brazilian NC of CIGRE, Brazil; Eletrobras Eletronorte; ²Brazilian NC of CIGRE, Brazil; TrassÑnio Consultoria

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**The painful (and expensive) experience of having to remedy an avoidable stator failure**

Rafael FERREIRA, André GARGHETTI

Brazilian NC of CIGRE, Brazil; CGT Eletrosul

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**Application of Non-contact On-line Partial Discharge Monitoring System to Hydro Generator**

Tomoaki TAKAHASHI, Makoto TAKANEZAWA, Takashi HARAKAWA, Akira FUJIMOTO, Hirotaka TSUBAKIHARA, Hideyuki NAKAMURA

Toshiba Energy Systems & Solutions Corporation, Japan

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<td><strong>Keywords:</strong> EL CID, low flux core test, electromagnetic core test, high flux core test, high frequency, hot spot, interlaminar insulation, core fault, stator core</td>
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**Low Flux Core Testing of Rotating Electrical Machines at Elevated Excitation Frequencies**

Nick STRANGLES¹, Mladen SASIC¹, David R BERTENSHAW²

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<td><strong>Keywords:</strong> diagnostics, hydrogenerator, stator to rotor eccentricity, vibration and air-gap measurements</td>
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**Mechanical Diagnostic Campaign of a 415 MW Vertical Francis Hydro-Unit**

Ozren ORESKOVIC¹, Ozren HUZNJAK¹, Damijan CERINSKI², Andrija KOSTELAC², Lucas Eduardo GUNE³

¹Veski Ltd Croatia; ²4-cube Croatia; ³Visum Energy Croatia; ⁴hidroeléctrica de Cahora Bassa Mozambique

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**Locate Generator Stator Phase-to-ground Fault Point by Burn-out Test**

Aticha WONGKHAMLA, Passapong PORNPHACHARAPUN, Yodsanon WITITTHUMAKUN, Apichart PALATORNPARIRUK

Electricity Generating Authority of Thailand (EGAT), Thailand

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**Case Study: How Pitch Imbalance May Affect Vibration and Performance in a Wind Turbine**

Marcos H. N. NISHIOKA, Emerson L. do NASCIMENTO, Vitor POHLENZ, Tiago K. MATSUO

AQTech Brazil
Impact of Front of Wave Impulse Testing on Dielectric Design of Transformer
Dharam VIR, Pradeep RAMASWAMY, Tim ROCQUE, Ajith VARGHESE
Prolec-GE Waukesha, United States of America

Comparison of Structural Strength of UHV AC Transformers with Different Outgoing Modes under Arc Fault in Oil
Yikun ZHAO1, Ke WANG3, Jinzhong LI3, Shuqi ZHANG1, Jiaxi Li1
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Research on the Static Stress Distribution of Winding Transposition Structure under External Short-circuit Fault
Yi ZHAO1, Tao WEN1, Weijiang CHEN2, Guanjing ZHANG1, Ke WANG3, Jinzhong Li3
1Hefei University of Technology, China; 2the State Grid Corporation of China, China; 3Xi'an Jiaotong University, China; 4China Electrical Power Research Institute, China

Transformer Winding Deformation Monitoring Technology Based on Distributed Fiber Optic
Peng LI, Zhengyu XU, Zuoxian WANG, Shuqi ZHANG, Huanchao CHENG
CEPRI, China

Research on Analysis for Fire and Explosion Prevention Capability of Large Transformers and its Improvement Measures
Jun DENG, Zhicheng XIE, Zhicheng PAN, Haibin ZHOU
China Southern Power Grid, Co., Ltd., China

Insulating liquid requirements for power transformers
Christophe PERRIER, Marielle MARUGAN, Sébastien LOUISE, Juliette SULPICE
GE Grid Solutions, France

Stresses on Power Transformers in Floating Offshore Applications
Triomphant NGNEGUEU1, Max GILLET2, Vivekkumar CHAUBEY1, Rupesh DARIPA2, Oguzkan SENTURK2, Tobias STIRL4, Jian ZHANG1, Hongbiao SONG6
1Grid Solutions, GE Vernova, France; 2Grid Solutions, GE Vernova, India; 3Grid Solutions, GE Vernova, Turkey; 4Grid Solutions, GE Vernova, Germany; 5Grid Solutions, GE Vernova, China; 6Grid Solutions, GE Vernova, USA
Natural Ester in Arc-Furnace Transformers for Steel Production

Fabio SCATIGGIO1, Rainer FROTSCHER2, Cristian CHITTARO3, Fabrizio FERRARI4, Giorgio CAMPIT, Daniele GIRO5, Luca LOMBINI4
1A&A Fratelli Parodi, IT; 2Maschinenfabrik Reinahusen GmbH; 3BS Acciaierie Bertoli Safau; 4Tamini Trasformatori S.r.l.; 5A.&A. Fratelli Parodi SpA

Thermal and Electrical Designs of Transformers by Considering Different Insulating Liquids

Qiang LIU1, Sicheng ZHAO1, Haichuan YU1, Zhongdong WANG1, Mark WILKINSON2, Massimo NEGRO3, Christoph KRAUSE3, Andree HILKE4, Ed Van SCHAIK5, Muhammad DAGHRAH5, Attila GYORE6
1The University of Manchester UK; 2SGB-SMIT Group Netherlands; 3Weidmann Electrical Technology AG Switzerland; 4Shell Global Solutions Germany; 5Shell Downstream Services International BV Metherland; 6M&I Material Ltd UK

Challenges regarding Factory acceptance Test of large offshore Shunt Reactors

Daniel WIKBERG
Hitachi Energy Sweden AB, Sweden

GIC Field Test on 500 kV Single-Phase Transformers

Bart SIMONS1, Luc DORPMANN2, Roland BRANDIS2, Adedasola A. ADEMOLA2, Andy SCHUETZINGER2, Robert ORNDORFF2, Marlu DEVERICK2, Francisco VELEZ-CEDENO2, Katelynn VANCE2, Micah J. TILL2, Mike LAMB2, Matthew GARDNER2, Emanuel BERNABEU3
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Dynamic model analysis of shell power transformers under short circuit vibration and the influence in the tank design

Miguel AGUIRRE1, Daniel GARCÍA-VALLEJO2, Jesús VÁZQUEZ3, Carlos NAVARRO3, Jaime DOMÍNGUEZ-ABASCAL2
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Design of transformers suitable for different insulating liquids

Andres AGUADO, Iazkun ARICETA, Diego LUMBRERAS, Miguel MARTINEZ
i-DE Redes Eléctricas Inteligentes, Spain

Transformer Sustainable Refurbishment for Ultra Long-Life

Ed TENYENHUIS1, Lars Andreas ERIKSSON2, Goizeder PAJARO3
1Hitachi Energy, Canada; 2Hitachi Energy, Norway; 3Hitachi Energy, Spain
Resilient Transformers – holistic Approach considering Aspects in Operation, Maintenance and Design

Radoslaw SZEWCZYSK1, Jean-Claude DUART2, Anastasia O’MALLEY3, Robert MAYER4, Ewald SCHWEIGER5

1 DuPont, Poland; 2 DuPont, Switzerland; 3 Consolidated Edison Co. of NY, USA; 4 Siemens Energy, Austria; 5 Siemens Energy, Germany

ID: 10659

Optimized design methodology of a resilient power transformer

Mphumzi KHOZA

ACTOM HIGH VOLTAGE EQUIPMENT

ID: 10660

Multidisciplinary approach to achieving resilient transformers – an end user perspective

Sidwell MTETWA

Eskom Holdings SOC Limited

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Swiss Experience in IEC Short Circuit Testing of Distribution Transformers

Marcel STOECKLI1, Bruno BOSNJAK*2, Rolli FLURI3, Davide BOTT2

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Design evaluations with advanced insulation systems for resilient transformers

Marcel STOECKLI1, Jean-Claude DUART*2, Radoslaw SZEWCZYSK1, Peter HATOS1, Marco MILONE1, Frank KUEBLER5

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ID: 10733

GIC Test with Mock-up Transformer for Verification of Temperature Rise Calculation

Heesung YOON, Myung Gong SOHN, Tae Sung PARK, Cheul Hyeok CHANG, Woo Heng HEO

Hyosung Heavy Industries, Korea, Republic of (South Korea)

ID: 10784

Power Transformer Protection against Geomagnetic Induced Currents: Thyristor Neutral Earthing

Aleksandr KHRENNIKOV1, Alexey KUVSHINOVO, Vera VAKHNINAR

1 S&T Centre of Rosseti FGC UES, Russian Federation; 2 Togliatti State University, Russian Federation

ID: 10785

Identification of Switching Operations Leading to Harmful Fast Transient Overvoltages in Power Transformers

Vasily LARIN1, Anton ZHUYKOV2, Daniil MATVEEV3, Mikhail FROLOV3, Andrey SELUKHANOVICH4, Alexander SMIRNOV5

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<td>Specifications for a Calculation Procedure to Achieve an Adequate Arc-Resistant Design for Power Transformers and Reactors</td>
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<td>Jean-Bernard DASTOUS</td>
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<td>Dietrich BONMANN1, Roald KLEIVI2, Claes CARRANDER3</td>
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<td>Olivier VACHERON*, Mohamed RYADI†, Dominique SOURIE*, Jean SANCHEZ‡</td>
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<td><strong>Calculation of Internal Transformer Overvoltages for Non-Standard Impulse Waveforms</strong></td>
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<td>Zvonimir JURKOVIC¹, Bruno JURISIC¹, Mladen MARKOVIC², Tomislav ZUPAN¹</td>
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<td>Igor TELALOVIC</td>
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<td><strong>Impact of Cellulose Degradation on Space Charge Dynamics and Conductivity of Synthetic Ester Liquid-Impregnated Kraft Paper Insulation</strong></td>
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A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics
Keywords: Powers transformers, maintenance, critical outage, technical policies, strategy

**RTE’s Large Power Transformers: new fleet management strategy**
Abasse TIMERA1, Rudy BLANC1, Benoît IZAC2, Philippe CLAUDE3
1RTE France Substation Expertise Dpt., France; 2RTE France Asset Management Dpt., France; 3RTE France R&D Dpt., France

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A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics

**Vibration Characteristics and Typical Mechanical Failure Analysis of Converter Transformer**
Zhicheng PAN, Jun DENG, Zhicheng XIE, Haibin ZHOU
China Southern Power Grid, Co., Ltd., China

ID: 10317
A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics
Keywords: Degree of Polymerization, Dielectric Frequency Response, Insulation Transformers, Mineral Oil, Moisture

**Analysis of Non-accelerated Thermal Aging of Model Windings Immersed in Mineral Oil and Natural Ester**
Diego ROBALINO1, Matias MEIRA2, Raul ALVAREZ2, Fabio SCATIGGIO4
1MEGGER, United States of America; 2INTELYMEC (UNCPBA), Argentina; 3IITREE-FI-UNLP, Argentina; 4A&A Fratelli Parodi SpA, Italy

ID: 10318
A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics
Keywords: Transformer Aging, Life Assessment, Digital Twin, Numerical Simulation

**Power Transformer Digital Twin: Incorporating Thermodynamic and Water Diffusion Discrete Elements Model for Enhanced Aging Calculation**
Alan SBRAVATI, Luiz V. CHEIM, Mauricio SOTO
Hitachi Energy, United States of America

ID: 10403
A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics
Keywords: Dissolved Gas Analysis, Data Analytics, Power Transformer, Asset Management, Trend Detection, Rate of Change, Anomaly Detection.

**Data Analytics for Transformer Dissolved Gas Analysis to Aid Asset Management**
Zhongdong WANG1, Thathsara HERATH1, Qiang LIU1, Gordon WILSON2, Ruth HOOTON2, David WALKER2, Timothy RAYMOND2, Luke van der ZEL4
1The University of Manchester UK; 2National Grid Electricity Transmission UK; 3SP Energy Network UK; 4Electric Power Research Institute USA

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A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics
Keywords: Statistical Model – Data Mining – Polychlorinated Biphenyls –Asset Management – Pole Mounted Transformers

**Data Mining for Targeted PCBs Management of Pole Mounted Transformers**
ShengJi TEE, David NEILSON, Matthew JONES, Malcolm BEBBINGTON
SP Energy Networks UK

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A2 POWER TRANSFORMERS AND REACTORS - Full Papers
Topics: A2 PS2 - Advances in Transformer Analytics
Keywords: Power Transformer, CFD, Windings, Natural Ester

**Analysis of Simplifications and Accuracy of a Thermal-hydraulic Model of Core-type Power Transformer Winding**
Sandra COUTO, João SILVA, Beatriz OLIVEIRA, Catarina SOUSA, Ricardo CASTRO LOPES
Power Transformers R&D, Efacec Energia S.A., Portugal
Evaluation of the Hot-Spots' Location during Dynamic Loading of a Natural Ester Cooled Power Transformer
Beatriz OLIVEIRA, Catarina CORTE-REAL, João SILVA, Sandra COUTO, Ricardo CASTRO LOPES
EFACEC Energia, S.A., Portugal

Artificial Intelligence in Transformer Manufacturing
Robin AXELSSON
Hitachi Energy Sweden AB, Sweden

Application of Online Bushing Monitoring With Low Measurement Uncertainty
Marek ANDRZEJEWSKI¹, Wieslaw GIL¹, Maciej LECHMAN², Wiktor MASŁOWSKI¹, Piotr RYTKA²
¹MIKRONIKA, Poland; ²PSE S.A., Poland

The evolution of power transformer appraisal methodology towards an effective and efficient risk assessment for the South African power utility
Sidwell MTETWA
Eskom Holdings SOC Limited

The usefulness of capacitive moisture sensors in online gas analysers
Carl WOLMARANS
GE Vernova M&D

Non-uniform winding Temperature Distribution in directed cooling Mode
Tor LANERYD
Hitachi Energy Sweden AB, Sweden

Dynamic Loading of Transformers in Renewable Energy Generation: A Comparison of Traditional Methods and a Novel Thermo-Chemical Evaluation of Transformers Ageing
Wilerson CALIL, Alan SBRAVATI, Luiz V. CHEIM
Brazilian NC of CIGRE, Brazil; HITACHI ENERGY

Advancements in Dynamic Thermal Modelling of Power Transformers: Integrating Detailed Thermal Hydraulic Network Models
Patrick PICHER³, Federico TORRIANO⁴, Zoran RADAKOVIC², Marko NOVKOVIC²
³Hydro-Québec, Canada; ⁴University of Belgrade, Serbia
Thermal Modeling of Power Transformer and Shunt Reactor Using Physics-Informed Neural Networks

Jhelum CHAKRAVORTY1, Michele LUVISOTTO2, Nicolo RIPAMONTI3, Tor LANERYD4, Annamalai LAKSHMANAN4

1Hitachi Energy Research, Canada; 2Hitachi Energy Research, Sweden; 3Hitachi Energy Research, Switzerland

Detecting degraded bushings with DFR – A case study

Lars Andreas ERIKSSON1, Evgenii ERMAKOV2, Lars JONSSON2, Erik NICOLAISEN3

1Hitachi Energy Norway; 2Hitachi Energy Sweden; 3Statnett

Monitoring Clamping Pressure in 40 MVA Power Transformer: A Study of Short and Long-Term Trends

Inge MADSHAVEN1, Henrik ENOKSEN1, Stefan JAUFER2, Chritoph KRAUSE2, Borut PRASNIKAR3, Asgeir MJELVE4, Alexander RITBAUER5, Mohamed RYADI6

1SINTEF Energy Norway; 2Weidmann Switzerland; 3Kolektor Etra Slovenia; 4Elvia Norway; 5Siemens Energy Austria; 6EDF France

Improvement and Validation of IEC dynamic Transformer thermal Model

Tim GRADNIK1, Xiang ZHANG2, Irina LUPANDINA3, Remi DESQUIENS4, Alvaro PORTILLO5, Federico PORTILLO6, Patrick PICHET7

1Elektroinstitut Milan Vidmar (EIMV) Slovenian engineering and scientific research organisation; 2Manchester Metropolitan University; 3Technische Universität Wien; 4EDF France; 5Independent researcher; 6Independent researcher; 7Hydro-Québec

The Good and Bad about Online Transformer DGA Monitoring

Varun GOYAL
Hydro One, Canada

Digital Transformation of Power-Transformer Solid-Insulation Drying Process

Gerardo TAMEZ-TORRES, Enrique BETANCOURT-RAMIREZ
Prolec-Ge International, Mexico

Modeling and Simulation to Analyze the Propagation of the Partial Discharge UHF Signals and Localization of Their Source in the Power Transformer

Djordje DUKANAC
Joint Stock Company "Elektromreza Srbije", Belgrade, Serbia
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<td>Karsten VIERECK¹, Anatoli SAVELEV¹, Julia MASSMANN², Johannes VEIT²</td>
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<td>Daniel MARTIN¹, Stefan TENBOHLEN², Zeenat HANIF², Chris BECKETT³</td>
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<td>¹Essential Energy, Australia; ²University of Stuttgart, Germany; ³United Energy, Australia</td>
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<td>David ALVAREZ¹, Oswaldo ARENAS¹, Jhonatan ANAYA¹, Isabella ARANGO²</td>
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<td>Dennis ALBERT¹,², Andre WÜRDE³, Christoph ENGELEN¹</td>
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Alexei BABIZKI¹, Philipp BIRGMEIER¹, Martin GUTH¹, Rolf FUNK², Martin KNAPP²

¹Maschinenfabrik Reinhausen GmbH, Germany; ²Rheinische NETZgesellschaft mbH, Germany

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1Power Transformers R&D, Efacec Energia S.A., Portugal; 2Smart Power R&D, Efacec Energia, S.A., Portugal; 3Service R&D, Efacec Energia, S.A., Portugal

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1INEGI, Portugal; 2Efacec Power Solutions, SGPS, S.A., Portugal

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1IITREE-FI-UNLP; 2FI-UNLP

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**Experience in UHV AC / DC projects in India & China with fully composite external insulation of substation equipment**

Eric MOAL¹, Madhu SUDAN², Shuchen ZHOU³, Sida ZHANG²
¹JACKSON AND FRANK, France; ²GE India Industrial Pvt LTD., India; ³Jiangsu Shemar Electric CO., LTD, China

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Yilong LI¹, Zhao YUAN¹, Lixue CHEN¹, Shan LIU¹, Liming LIU¹, Penglong YA¹, Chuangci WU¹, Yuan PAN¹
¹Huazhong University of Science and Technology, China; ²State Grid Hubei Electric Power Research Institute Measurement

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Robert MIDDLETON, Eric EUVRARD
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1Cardiff University UK; 2SSEN Transmission UK

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Alexandre PINHEL, Rodrigo MAIA, Gabriel Ângelo VIEIRA, Anselmo THIESEN
1Brazilian NC of CIGRE, Brazil; Eletrobras Furnas; 2Brazilian NC of CIGRE, Brazil; SENAI-SC

An Advanced Intelligent Online Monitoring System for Current Transformers
George LIRA, Ana MAROTTI, Edson COSTA, Antonio LEITE NETO, João MELO, André COSTA, João Paulo DE SOUZA, Fabiana FERNANDES, Allan David SILVA, João Paulo SOUZA
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**Keywords:** SF6-alternative, High Voltage Circuit Breaker, CO2-O2-C4FN Gas Mixture, Current Interruption, Post-arc Current, Computational Fluid Dynamics

**SF6-alternative 145 kV metal enclosed circuit breaker**

Marcel STOECKLI¹, Patrick STOLLER², Mahesh DHOTRE², Brooke SPREEN², Jakub KORBEL²

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**Keywords:** High voltage circuit breakers, dielectrics, rise of dielectric withstand, controlled switching, SF6 alternatives

**RDDS and RRDS characterization for 420 kV 63 kA SF6-free High Voltage Circuit Breaker**

Marcel STOECKLI¹, Reto KARRER², Valeria TEPPATI², Mahesh DHOTRE², Sami KOTILAINEN², Peter FREI²

¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Hitachi Energy, Switzerland

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**Topics:** A3 PS2 - Lowering the Carbon Footprint of T&D Equipment

**Keywords:** High voltage circuit breakers, SF6 alternatives, C4-FN mixtures, computational fluid dynamic simulations, short line faults, terminal faults

**Development and type testing of a 420 kV 63 kA 50 Hz and 60 Hz SF6-free High Voltage Circuit Breaker**

Marcel STOECKLI¹, Valeria TEPPATI², Reto KARRER², Mahesh DHOTRE², Peter FREI², Patrick STOLLER², Markus BUJOTZEK²

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**Keywords:** SF6-free, C4-FN, dual-gas, GIS, CB, short-circuit, switching

**72.5 kV C4-FN/O2/CO2 GIS and CB performance and comparison with its SF6-equivalent**

Marcel STOECKLI¹, Maxime PERRET², Robert LUESCHER², Clement COCCHI², Bernhard SPICHLER², Alexis COMBAZ³

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**Keywords:** Decarbonisation, Environmental impact indicator, Gas insulated switchgear, High voltage circuit breaker, Life cycle assessment, fluoronitriles, Vacuum, PFAS, F-Gas

**Evaluation of Environmental Impact of SF6-based SP-3 and SF6-free GREENTRICtm 145 kV High Voltage Gas Insulated Switchgear through Life Cycle Assessment**

Marcel STOECKLI¹, Kedar PANDYA², Manuel GOTTI², Nicole SONG³, Javier MANTILLA³, Hyounjin JOO³

¹ELECTROSUISSE / CIGRE Switzerland NC Secretary; ²HD Hyundai Electric Switzerland Ltd, Switzerland; ³HD Hyundai Electric Ltd, South Korea

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**Topics:** A3 PS2 - Lowering the Carbon Footprint of T&D Equipment

**Keywords:** HVCB, CO2 footprint, decarbonization, C4F7N, GWP, F-gas regulations, x-ray emissions-free, CFD, MOO, terminal faults, recovery voltage, carbon-neutral, digital twin, condition monitoring

**Experience in the development of a Fluoronitriles-based 145 kV / 40 kA / 50-60Hz HVCB with an extremely low CO2 footprint**

Marcel STOECKLI¹, Manuel GOTTI², Kilsoo HAN¹, Jeong Cheol KIM¹, Sihyeong KIM³, Xiangyang YE¹, Javier MANTILLA², Kedar PANDYA²

¹ELECTROSUISSE / CIGRE Switzerland NC Secretary; ²HD Hyundai Electric Switzerland Ltd, Switzerland; ³HD Hyundai Electric Ltd, South Korea

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**Topics:** A3 PS2 - Lowering the Carbon Footprint of T&D Equipment

**Keywords:** Dielectric Design, Insulation, Type Test, SF6-alternatives, Gas-Insulated Switchgear, GIS, Dead-Tank Breaker, DTB

**High Voltage type testing of a 420 kV SF6-free High Voltage Circuit Breaker for Gas Insulated Switchgear and Dead Tank Breaker Applications**

Marcel STOECKLI¹, Peter FREI², Reto KARRER², Wilhelm THUNBERG², Valeria TEPPATI², Brian CHRISTOPHER², Marc CUPPETT³, Carl R. KURINKO³

¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Hitachi Energy, Switzerland; ³Hitachi Energy, United States
Future Needs and Common Approach of the Implementation of SF6 Free Equipment in the Grid of Six European TSOs
Frank RICHTER, Lisa SCHAEFER, Aurélien TAUREAU, Jonas BAUMANN, Thomas WIJNOVEN, Maria Isabel MARTIN DIAZ-TOLEDO, Patrick SCHOERNBÖCK, Pierre MEYER
150Hertz Transmission GmbH, Germany; ²RTE, France; ³Swissgrid AG, Switzerland; ⁴Elia Transmission, Belgium; ⁵REDEIA, Spain; ⁶APG, Austria

SF6 Free 170kV 50kA GIS verification test considering substation energization
Sooik LEE, Dongwook MOON, Kwangjoong LEE, Seungwan SON
Hyosung Heavy Industries Corporation, Republic of (South Korea)

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Paul Gregor NIKOLIC, S. WILKE, A. GRIEGER
Siemens Energy, Germany

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Man-Jun HA, Jung-Ho PARK, Dong-Hoon JEONG
Hyosung Corporation

A Common LCA Format for High-Voltage Switchgears
Toshiyuki UCHII, Satoshi TAKAHASHI, Haruhiko KOYAMA
¹Toshiba Energy Systems & Solutions Corporation, Japan; ²JEMA (The Japan Electrical Manufacturers’ Association), Japan

Lifetime Aspects and Experiences through Commercial Operations of 72 kV SF6-free Gas-Insulated Switchgear using Natural Origin Gas
Tomoya ONISHI, Toru KOIKE, Akihisa MUKAIDA, Hideaki SHIRAI, Shigeyuki TSUKAO, Syuichi TAMURA
¹Toshiba Energy Systems & Solutions Corporation, Japan; ²TEPCO Power Grid, Inc., Japan

Application of SF6 alternative switchgears – circuit-breakers and GIS using vacuum interrupter in synthetic air-insulated systems –
Naoya AIHARA, Ryosuke ITOHARU, Koki SADAHIRO, Shinichiro NAKAUCHI, Kenji SASAMORI
¹Mitsubishi Electric Corporation, Japan; ²Kansai Transmission and Distribution, Inc., Japan
Long operational experiences of medium-voltage solid-insulated switchgears
Satoru MAENO¹, Yuk ISHIKAWA², Ryosuke ITOTANI³, Yoshimitsu NIWA⁴, Hiroyuki SHIRAI⁵
¹Mitsubishi Electric Corporation, Japan; ²TEPCO Power Grid, Inc., Japan; ³Kansai Transmission and Distribution, Inc., Japan; ⁴Toshiba Infrastructure Systems & Solutions Corporation, Japan; ⁵Hitachi Industrial Equipment Systems Co., Ltd., Japan

SF6 alternatives in GIS/AIS Switchgear and challenges faced in its execution and project management
Ravi Sushant CHAUDHARY*, Anshul SHARMA, R. P. S. RANA, M. THIRUMALA
POWERGRID, India

Subject - Life cycle management and life extension of AIS/GIS Switchgear, FACTS equipment by application of RCM
POWERGRID, India

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Roman PERNICA, Karol MAJER, Pavel VANO
ABB Czech Republic

Digital model and supply chain of a MV GIS, to manage a low carbon energy system
Thomas DUERR, Achim KALTER, Florian WOLFRUM, Patrick SCHNEIDER
Siemens AG & Siemens Ag France, Germany

Implementation of Various Biodegradable Insulation Liquids in Instrument Transformers Rated at 420 kV
Kresimir KOPRIVEC¹, Igor ZIGER², Darko IVANOVIC³, Tomislav ZUPAN²
¹Končar – Instrument Transformers Zagreb, Croatia; ²Končar – Electrical Engineering Institute Zagreb, Croatia

Molecular Dynamics Simulation of Cathode Spots Formation and Contact Erosion in Vacuum Circuit breakers
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University of Manchester, UK

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Research on Magnetic-controlled Vacuum Arc Technology and Circuit Breaker Development

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Health Index computation in Switchgear Monitoring Systems: providing Asset Performance Management crucial data straight from the primary equipment

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Return on Experience of Smart Live Tank Circuit Breaker with SF6-Alternative

Nicolas GADACZ1, Henrik Roland HANSEN2
1GE Vernova, France; 2Energinet, Denmark

Enhancing Fault Detection and Classification in Power Transmission Systems Using Two-stage Detection System

Hassan MAHMOUD1, Haitham H MAHMOUD2
1Egyptian Electricity Holding Company; 2Birmingham City University

Condition Monitoring Analyses: from Straightforward to Surprising

Tony MCGRAIL1, Philip BOREHAM1, Jamie BEARDSALL1, Mark ROWBOTTOM2, Carl JOHNSTONE1, Rachael SUH4
1Doble Engineering, United States of America; 2Drax Power, United Kingdom; 34 Asset Management, United Kingdom; 4Energy Harbor, United States of America

Utilizing Asset Performance to Guide Asset Replacement and Maintenance Optimization Decisions at TVA

Jeffrey H. NELSON1, Jay JAYARAMAN2, Siri VARADAN3
1Tennessee Valley Authority, United States of America; 2Hitachi Energy, United States of America; 3Quanta Technology, United States of America

Towards online condition assessment of oil-paper insulated current transformers: experiences from laboratory experiments

Daniël WOLDENDORP, Sjoerd NAUTA, Reinder PETERSE
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**Smart Sensor with Embedded AI Model for Automatic Detection of PD Defects in Distribution Networks**
Javier ORTEGO¹, Elvis JORGE¹, J. David BIELVA², Antonio GONZALEZ²
¹Ampacimon, Spain; ²EDP Redes Spain, Spain

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**Monitoring 245 kV instrument transformers using AI for condition assessment and operation optimization**
Amaia RECALDE¹, Jone JUIZ¹, Itxigo HUERTA¹, Jesus SAEZ², Mikel FERNANDEZ², Jose Antonio EGUREN³
¹Arteche Group, Spain; ²Tecnalia, Spain; ³i-DE (Iberdrola), Spain

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**A Wireless Self-Powered and Edge Computing Sensor for Power Quality and Grid Analysis**
Antonio-Miguel MUÑOZ-GÓMEZ¹, Alfonso MARECA-MIRALLES¹, Javier BALLESTÍN-FUERTES¹, José-Francisco SANZ-OSORIO²
¹Circe, Spain; ²University of Zaragoza, Spain

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**Keywords:** Frequency response measurement, white noise, instrument transformers, test voltage level, frequency bandwidth, power quality

**Test voltage level analysis for frequency response measurements on instrument voltage transformers**
Mathieu NADEAU¹, Erik SPERLING², Roberto SCHULZE³
¹Hydro-Québec, Canada; ²OMICRON Energy, Switzerland; ³OMICRON Energy, Germany

**ID: 10711**
A3 TRANSMISSION AND DISTRIBUTION EQUIPMENT - Full Papers
Topics: A3 PS3 - Maintaining and Management T&D Assets

**Keywords:** IEC 61850, Optical Current Transformer, Low-Power Instrument Transformer, Substation Instrumentation, Faraday Effect, Process Bus Integration, Comparative Analysis, Laboratory Testing, TECO, Substation Technology

**Assessment of Critical Aspects Related to Optical Current Transformer Measurements**
Carlos DUTRA¹, Luan TOMINAGA¹, Vitor WOYAKEWICZ², Tiago MATSUO²
¹Brazilian NC of CIGRE, Brazil; PowerOpticks; ²Brazilian NC of CIGRE, Brazil; AQTech

**ID: 10726**
A3 TRANSMISSION AND DISTRIBUTION EQUIPMENT - Full Papers
Topics: A3 PS3 - Maintaining and Management T&D Assets

**Keywords:** Electric Stray Field, CR Divider, Voltage Divider, Accuracy, Frequency Response Behaviour, Power Quality

**Investigation of the impact of external stray fields on voltage divider accuracy for 36 kV and 123 kV system voltage levels**
Marcel STOECKLI¹, Erik SPERLING³, Roberto SCHULZE⁴, Thomas HEID⁴
¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²OMICRON energy, Switzerland; ³OMICRON energy, Germany; ⁴CONDIS SA, Switzerland

**ID: 10727**
A3 TRANSMISSION AND DISTRIBUTION EQUIPMENT - Full Papers
Topics: A3 PS3 - Maintaining and Management T&D Assets

**Keywords:** power quality monitoring, transient monitoring, CR-divider, RC-divider, low-power voltage transformer

**High bandwidth low-power voltage transformers for power quality measurement and fast transient monitoring in MV and HV substations - technological overview and experience from field installations**
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¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²CONDIS SA, Switzerland; ³Artemes GmbH, Austria; ⁴HEIA Fribourg University of Applied Sciences, Switzerland
Asset Performance Management System Design for a Modern TSO
Ales HVALA, Andrej F. GUBINA, Despoina MAKRIDOU, Anastasios PATSIOTIS
1Blueprint Energy Solutions, Austria; 2RI UL, Slovenia; 3TSO Greece

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1Powerlink QLD Australia; 2The University of Queensland, Australia

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1OMICRON electronics; 2Graz University of Technology

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Toshiaki KONO, Ryoichi SHINOHARA, Hiroaki HASHIMOTO, Li LU
Hitachi Ltd., Japan

Robotic isolation of MV breakers and condition monitoring using AI and AR
Ravi SAHU, Amit PATEL, Ashish MHATRE, Kapil UMAK
Tata Power Co. Ltd, India
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<td>Rashmi* CHAUDHARY, B. P. SONI, Dr. A. J. CHAVDA</td>
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<td>110 KV GOD Routine Maintenance Robotic Cleaning and online Monitoring of Switchyard Equipment's</td>
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<td>Research on UHF Sensor Signal Attenuation Simulation Method for Improvement of GIS Partial Discharge Diagnosis</td>
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<td>In-service circuit breaker condition assessment</td>
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<td>Phil MOORE¹, Keith WILLIAMS², Mark WALDRON³</td>
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| ¹Elimpus Ltd UK; ²National Grid UK
**Benefits of Smart Generator Circuit Breaker Solutions from a Manufacturer-Utility Collaboration Perspective**

Vitsanu PHONPHAI1, Nicolas GADACZ2, Charcrist KUHAKARN1, Panupan THAKONG1

1Electricity Generating Authority of Thailand (EGAT), Thailand; 2GE VERNOVA, France

**Applying a Deep-Learning Method to Diagnose the Capacitor Voltage Transformers with Excessive Measurement Errors**

Hamid Reza MANSOURI1, Mohammad Majid JALALI1, Hojjat DEZFULI2

1Niroo Trans Co.; 2Monenco Iran Consultant Engineering Co., Iran, Islamic Republic of

**Real-time pollution monitoring and diagnostics of Air Insulated Switchgear oriented to predictive maintenance**

Rodolfo SARACENI1, Alberto PIGINI2, Marco NOSILATI1, Eros STELLA1

1GE Vernova Italy; 2Independent Consultant Italy

**220kV three-core submarine cable armouring loss test**

Yuantao ZHAO1,2, Kanghong LIU1, Mingyue LIU2, Guojun YU2, Fan YANG2, Feng XIA2, Fei LI1, Lisheng ZHONG1

1Xi’an Jiaotong University, China; 2Ningbo Orient Wires & Cables Co., Ltd., China

**A Location Method of Local Defects in Power Cables Based on Reflection Coefficient Spectrum**

Kai ZHOU, Yao FU

Sichuan University, China

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Raquel MARCHENA1, Annalisa VERRILLO2, Nicolas BOUVIER1

1Prysmian Group, France; 2Prysmian Group, Italy
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Lucia DE MERICH
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On-spot PD Measurements on Singapore 22 kV XLPE Circuits: Experiences and Challenges

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\textsuperscript{1}TenneT; \textsuperscript{2}Crisislab; \textsuperscript{3}Radboud Universiteit

A selection of identified gaps in cable installation engineering and mechanical testing standards

Barend BENTVELSEN, Daniel LIEFFERINK
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Pjotr MUIS, Colin VAN WIJK, Ramon CREYGHTON, Anna VAN VELEN, Joan RESSING, Sjoerd NAUTA
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Results of PQ Test and Various Type Tests for AC 400kV Submarine Cable System
Hunjin LEE
LS Cable&System, Korea, Republic of (South Korea)

Bend Stiffness Test For Cable Considering Tension During Installation Or Operation
Chulmin KIM1, Jaebok LEE2, Kwangsu CHAE3, Yuho RHO4, Chunsik SHIM5
1LS Cable & System Ltd; 2Mokpo National University

Failure Statistics of High Voltage Underground Cables in Urban Areas – Experience of the Southeastern Brazilian Large City Centers
Carla DAMASCENO1, Adilson MENEZES2, Paulo DEUS3, Daniel Lucas SILVA4
1Brazilian NC of CIGRE, Brazil; Consultor; 2Light SESA; 3Enel SP; 4ISA-CTEEP

Challenges and solutions to implement an underground transmission line in the biggest city of Brazil
Jody FUJIHARA1, Rogerio LAVANDOSCKI1, Gabriela RODRIGUES1, Julio LOPES2
1Brazilian NC of CIGRE, Brazil; ISA CTEEP; 2INOVATEC

Learnings from a third party accident in a 220 kV underground transmission line in Colombia
Julio LOPES1, Antonio PEDRAZA2
1Brazilian NC of CIGRE, Brazil; INOVATEC; 2ISA

The Construction of High Voltage Underground Lines Using Two Cables Per Phase in Large Cities - Their Motivations, and Installation and Maintenance Complexities
Paulo DEUS, Eduardo LEANDRO, Artur CONFORTI
Brazilian NC of CIGRE, Brazil; INEL

Limitation of Switching Overvoltage as a Way to Provide the Reliability of Power Cable Lines
Ian KOROSTELEVI1, Rasim BABAEV2, Anton KORZHOV3, Mikhail DZIUABA4, Valery SAFONOVI2
1Energy+21 JSC / South Ural State University, Russian Federation; 2South Ural State University, Russian Federation
ID: 10879
B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences
Keywords: EPDM PMJ, HVDC PMJ, PMJ

Development of EPDM Insulation Material for 500kV-class HVDC PMJ
Yeonwoo JO, Jaecheol JUNG, Dongseok HONG, Hyunjoo KIM
TAIHAN Cable&Solution, Korea, Republic of (South Korea)

ID: 10892
B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences
Keywords: Thermal assessment, Semi-conductive PE Sheath, HVDC, Fault Simulation

Thermal assessment of the transition joint between insulating and semiconductive inner PE sheath
Abbas LOTFI, Martin HOVDE, Allen TUNHEIM
Nexans Norway AS

ID: 10950
B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences
Keywords: Siphon underground XLPE cable system - cross-bonding - earth continuity conductor - insulation coordination

420 kV underground cable system in environment with high electrical resistivity of soil. Use of an earth continuity conductor in combination with cross bonding and consequences on insulation coordination
Jerome MATALLANA1, Kostas VELITSIKAKIS2, Thinus DU PLESSIS2
1Statnett, Norway; 2TENNET The Netherlands

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B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences

Dynamic Analysis on HVDC Land Cable and prefabricated Joint under Salt-mine Blasts
Yang ZHOU
NKT AB, Sweden

ID: 11130
B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences
Keywords: Cable, Optioneering, Consenting, Ireland, EirGrid, Cable-system-design

Optioneering and consenting of a 50km 400kV underground cable connection
Emanuele SALOMONE1, Neil COWAP2
1IACOBS UK; 2EirGrid Ireland

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B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences

Development of an extended commissioning program for temporary 220 kV cable connections
Alexander PIRKER1, Anita MACHL2
1Verfahren Umwelt Management GmbH; 2Austrian Power Grid AG

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B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences

The role of quality assurance in a high voltage cable market shaped by the energy transition from a grid operators’ perspective
Florian AINHIRN, Andreas BOLZER
Wiener Netze

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B1 INSULATED CABLES - Full Papers
Topics: B1 PS1 - Learning from Experiences

Derivation and Application of a Sustainability Assessment System for the Installation of High and Extra-High Voltage Cables in the City of Vienna
Florian AINHIRN1, Michael KLEIN1, Alicia OGRYSEK3, Lea ORTH2
1Wiener Netze; 2Technical University Vienna
**ID: 11181**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**New approaches in performing commissioning tests in HVAC on long land and inter array cable projects using Resonant Test Systems**

Peter MOHAUPT¹, Marco BRAMBILLA², Emilio DEL RIO RUIBAL²

¹Mohaupt HV; ²Prysmian Powerlink

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**ID: 11188**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Experiences and Perspectives in the Application of the BIM Methodology to the Design and Construction Phases of Underground Transmission Lines for the "El Río" 220 kV Project**

Hernan RESTREPO, Antonio PEDRAZA, Luis SARMIENTO

ISA Intercolombia

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**ID: 11193**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Keywords:** Cable Condition Monitoring, HV Cable, Cable Termination, Cable Joint, Passive Sensing, Distributed Electrical Sensing, Sheath Current, IEC 61850-9-2, Sampled Values

**Installing passive sensing for condition monitoring of a 400 kV cable**

Steven BLAIR, Neil GORDON, Iain MCKEEMAN, Philip ORR, Marcus PERRY

Synaptec UK

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**ID: 11258**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Insulated Cables Statistics 2012 to 2021**

Russell WHEATLAND¹, Soren MIKKELEN², Francis WAITE², Kim ove ASKLUND², Peter van der WIELEN³, Andrew WOOLÈ⁴

¹Ausnet Services, Australia; ²Energinet, Denmark; ³Balfour Beatty, United Kingdom; ⁴Hafslund Nett, Norway; ⁵DNV, Netherlands; ⁶TE Connectivity, New Zealand

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**ID: 11275**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Keywords:** Natural Degradation, Pre-breakdown, Discharge Detection, Water Tree, Wet Design, XLPE, Asset Management

**Assessment and asset management of aged 66 kV – 77 kV wet design XLPE cable**

Shoji MASHIO¹, Kimihiro IWASAKI², Takeshi KAYA³, Toshihiro TAKAHASHI⁴

¹Sumitomo Electric Industries, Ltd., Japan; ²TEPCO Power Grid, Incorporated, Japan; ³Kansai Transmission and Distribution, Inc., Japan; ⁴Central Research Institute of Electric Power Industry, Japan

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**ID: 11279**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Keywords:** Optimization, Rationalization, Replacement, Y-branch joint

**Challenges and Initiatives for replacement of aged SCFF or HPFF cables to XLPE cables**

Hiroki YOKOTA¹, Masahiro NARITA¹, Kimihiro IWASAKI², Hidenori SATOU², Takeshi KAYA³, Tatsuhiko SAKAMOTO³

¹Furukawa Electric Co., Ltd., Japan; ²TEPCO Power Grid, Incorporated, Japan; ³Kansai Transmission and Distribution, Inc., Japan

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**ID: 11307**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Keywords:** Ampacity, Cable, Harmonic, Triplen

**Cable Current rating in the presence of Harmonics**

Andreas CHRYSOCHOS, Konstantina BITSI, Iordanis CHALEPLIDIS, Dimitrios CHATZIPETROS, Varvara RIZOU, Vasileios KANAS

Hellenic Cables, Greece

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**ID: 11308**

**B1 INSULATED CABLES - Full Papers**

**Topics:** B1 PS1 - Learning from Experiences

**Keywords:** Cable System, Direct Cross Bonding, Insulation Coordination, Lightning, Overvoltage

**Evaluation of Cable Bonding Scheme under Lightning Overvoltages in HVAC Modern Siphon Systems**

Christos TRAIANOS, Iordanis CHALEPLIDIS, Andreas CHRYSOCHOS, Dimitrios CHATZIPETROS

Hellenic Cables, Greece
Modeling of the Thermoelectric Performance of Offshore Power Cable Joints
Konstantina BITSI, Dimitrios CHATZIPETROS, Andreas CHRYSOCHOS, Vasileios KANAS
Hellenic Cables, Greece

Electric field analyzes in heat-shrink cable terminals depending on the assembly and defects parameters with FEM
Yunus Berat DEMIROL1, Elif SAKALLIOGLU1, Bora ALBOYACI2, Mehmet Aytaç CINAR2
1Genetek Güç&Enerji, Türkiye; 2Kocaeli University, Türkiye

A Machine Learning-Induced Cable Health Indexing Model for Utilities
Akshat KULKARNI*, Sanjeev KUMAR, Pratik BAJARIA, Yash KULKARNI
OrxaGrid Pvt Ltd, India

Performance Evaluation of Thermoplastic Polyolefin (TPO) MV Cables – an alternate to MV XLPE Cables
Yogendra S. TIWARI*, C. S. MOHANTY
Universal Cables Limited, Satna (MP), India

Improvisation in Laying & Installation of HV/EHV Power cables in extreme challenging conditions
Puneet CHAWLA, Jai KUMAR, Dileep K. SHUKLA, Vivek KAPIL, Aruna GULATI
BHEL, India

Investigating Overvoltage Phenomena and Partial Discharge Characteristics in Medium Voltage Underground Cables
for Enhanced Reliability and Performance
Ayham BAKEER, Tarq ALNATOUR, Muawiyah ABOALHUMOS
Jordan Electric Power Company

Single Sheath Bonding Method To Eliminate Earth Continuity Cable
Mohamed KHAN
Electricité De France, UAE

Challenge of TDR Fingerprint on Viking Link
Henrik Roland HANSEN1, Manfred BAWART2, Marco BRAMBILLA3, Emilio DEL RIO RUibal1
1Energetin; 2BAUR GmbH; 3Prysmian Powerlink
Calculation of Magnetic Fields around Stranded 3 core cables
Thomas KVARTS, Anna Candela GAROLERA
Ørsted Wind Power a/s

Data-Driven Laying Condition Assessment of High Voltage Cables using Distribute Temperature Sensing - DTS
Soumya THAKUR1, Joachim HOLBØLL1, Joachim NIEMANN-LARSEN2
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Requirements for onsite test systems for the after-installation test of HVDC cable systems
Marcel STOECKLI1, Michael GAMLIN1,2, Carl-Hendrik STUCKENHOLZ2, Tobias MUELLER2, Manuel ECKERT2
1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2Haefely AG, Switzerland

Complete power cable monitoring for floating marine energy technologies
Pierre CLEMENT1, Gaetan CALBRIS1, Caroline LOURIE2, John EMEC2
1FEBUS Optics, France; 2EMEC Ltd, UK

Theft prevention solutions against earth continuity conductor in galleries
Alicia JANDIN, Matthieu CABAU, Mathieu GROULT
RTE, France

Root Cause Analysis in Onshore Wind Farm MV Cable: A Study Based on IEEE 1511.1 Guide
Phelipe SILVA
BAUR do Brasil

Comparative Study on Detection Methods for Buffer Layer Defects in High-voltage XLPE Cable with Corrugated Aluminum Sheath
Yanpeng HAO1, Yanting CHENG1, Wanxing TIAN1, Qishun LI1, Haotian TAN1, Peng ZHAO2, Baojun HU2, Licheng LI1
1School of Electric Power Engineering, South China University of Technology; 2Jiaxing Power Supply Company of State Grid Zhejiang Electric Power Co., Ltd.; 3Electric Power Research Institute, China Southern Power Grid
**ID: 11897**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS1 - Learning from Experiences  
**Keywords:** High-Pressure Fluid Filled (HPFF), Cross-linked Polyethylene (XLPE), Self-Contained Fluid Filled (SCFF), Gas Insulated Substation (GIS), Cable.  

**Design, Qualification Testing and First Installation of a 138 kV High-Pressure Fluid Filled (HPFF) to Cross-Linked Polyethylene (XLPE) Transition Joint**  
Jake GELHARD  
EHV Power Inc., a USi Company

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**PS2 - FUTURE FUNCTIONALITIES AND APPLICATIONS**

**ID: 10134**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS2 - Future Functionalities and Applications  
**Keywords:** MVDC cables system, electrical field stabilization, proposition, qualification procedure, electrothermal stresses  

**Proposition of qualification procedure for MVDC cables**  
Amjad MOUHAIDALI1, Raphaël GUFFOND2, Ludovic BOYER1, Lina RUIZ2  
1SuperGrid Institute, France; 2Nexans, France

**ID: 10172**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS2 - Future Functionalities and Applications  

**Development and Experiment of Two-section Three-phase Coaxial 10 kV/1 kA HTS Cable with Three-phase Balance Design**  
Panpan CHEN, Jiahui ZHU, Qifan YANG, Yanfang YANG, Hongjie ZHANG  
China Electric Power Research Institute, China

**ID: 10328**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS2 - Future Functionalities and Applications  
**Keywords:** Routing, Superconductor, Transmission, Underground  

**High-Temperature Superconducting Cable Systems as a Solution to Underground Transmission Line Routing in Congested Project Areas**  
Collin EDWARDS, Darin LAWTON  
Burns & McDonnell, United States of America

**ID: 10331**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS2 - Future Functionalities and Applications  
**Keywords:** Underground Transmission, Submarine, Finite Element Modeling (FEM), Cable Ampacity  

**Developing an FEM Model of the TB880 3-Core Cable Case Study**  
Brian RUTHERFORD  
Burns & McDonnell, United States of America

**ID: 10405**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS2 - Future Functionalities and Applications  
**Keywords:** Temperature, Crosslinked-polyethylene (XLPE), Qualification Testing  

**Thermal limit of XLPE insulation: Is 90 still the magic number?**  
James PILGRIM1, Thomas ANDRITSCH2, Paul LEWIN2, George CALLENDER2  
1Ørsted Wind Power UK; 2University of Southampton UK

**ID: 10520**

**B1 INSULATED CABLES - Full Papers**  
**Topics:** B1 PS2 - Future Functionalities and Applications  
**Keywords:** HVDC, GIS, cable connection assemblies, dielectric testing, type test  

**Recommendations for dielectric testing of HVDC gas insulated cable connection assemblies**  
1DNV; 2Siemens Energy; 3Vattenfall; 4Nexans; 5SGI; 6Hitachi; 7TenneT; 8Prysmian; 9KEMA; 10SSEN Transmission; 11Furukawa; 12Pfisterer; 13UL; 14Tech4Speed; 15Brugg Cables
The development of a Route Survey Plough for subsea power cable routes

Wino SNIJ, Daniel LIEFFERINK, Barend BENTVELSEN
TenneT

Testing Experience on Temporary High Voltage Cable Connection Solutions

Panos TSAKONAS1, Corne VAN EEDEN1, Riccardo BODEGA1, Roy ZUIJDERDUIN2, Jacco SMIT2
1 Prysmian Group; 2 TenneT

Analysis of Parameters Affecting Current Rating of Cables Installed in J-tube for Offshore Wind Farms

Ruhi RUHI1, Tapabrata MUKHERJEE1, Camilo APRAEZ1, George J. ANDERS2
1 Eaton Energy Automation Solutions, Canada; 2 Lodz University of Technology, Poland

Feasibility Assessment of Solutions for the Introduction of High-Temperature Superconducting AC Cable Lines in Megacities

Andrey KASHCHEEV1, Mikhail DUBININ1, Victor SYTNIKOV1, Elena FILIPEVA1, Dmitriy SOROKIN2
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Motion Characterization of dynamic Cables with distributed acoustic Sensing obtained from Field Measurements

Simon DE RIJCKE1, Carlos ARBOLEDA1, Koen DE BAUW2, Antoine VERGAERDE1, Andrés MCKAY3
1 MARLINKS, Belgium; 2 ENGIE Laborelec, Belgium; 3 OCEAN WINDS, Spain

Evaluation of Thermal Network Modelling and Finite Element Analysis for Ampacity Rating Calculation of Wind Farm Export Cable

Camilla ESPEDAL, Henrik STRAND, Espen EBERG, Henrik STRAND, Espen EBERG
SINTEF Energiforsknings

Cable Dimensioning based on Wind Predictions in an Offshore Meshed Network

Tom EGAN1, Vasileios L. KANAS2, Andreas I. CHRYSOCHOS2, Nikolaos Ion BATISTATOS2, Maryam ZADFALLAH1, Henry ABRAMS1, Casey FONTANA3
1 Invenergy, United States of America; 2 Hellenic Cables, Greece
B1 INSULATED CABLES - Full Papers

**Qualification of Submarine AC Cables for 1500 m Water Depth**

Lisa JOHANSSON
NKT AB, Sweden

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**Development and Validation of a Third-Party Intrusion Detection Software Based on DAS Measurement Data**

Florian ALINHORN1, Andreas BOLZER1, Werner LIENHART2, Lisa STRASSER2
1Wiener Netze; 2Graz University of Technology

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**Dynamic cable rating with partial drying of the soil**

Robert SPICE1, Martin HIRD1, Justin DIX1
1ITP Energised UK; 2University of Southampton UK

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**Superconducting Power Cable For 500 MVA at 110 kV in Munich - First Insights in the Test Run**

Robert BACH1, Robert PRINZ2, Werner PRUSSEIT1, Dag WILLEN1, Patrick MANSHEIM1, Alexander ALEXSEEV5, Wescley Tiago BATISTA DE SOUSA4
1South Westphalia University of Applied Sciences, Germany; 2NKT Cables Group, Denmark; 3SWM Infrastruktur GmbH & Co. KG, Germany; 4THEVA Dünnschichttechnik GmbH, Germany; 5Linde Kryotechnik AG, Germany; 6Karlsruher Institut für Technik, Germany

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**Integration of Photovoltaic considering Dynamic Transformer Rating in the Distribution Grid Planning Process**

Moritz FRANZ1, Martin BRAUN2, Jan WIEMER2, Denis MENDE1
1Universität Kassel, Germany; 2Fraunhofer Institut für Energiewirtschaft und Energiesystemtechnik IEE & Universität Kassel, Germany

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**Concept and development of a digital twin of a 110-kV-cable line**

Robert BACH1, Rouven BERKEMEIER2, Judith SCHRAMM2, Carsten WOLFF3
1South Westphalia University of Applied Sciences Soest, Germany; 2Fachhochschule Südwestfalen, Abt. Soest, Germany; 3Rheinische NETZGesellschaft mbH, Germany; 4NKT GmbH & Co. KG, Germany

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**High Reliability Zero Failures in Underground and Underwater Transmission Systems**

Pablo REALPOZO1, Victor SIERRA-MADRIGAL2, Jose Luis GARCIA-URRESTI2
1CFE, Mexico; 2CIGRE México, Mexico

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**New HVDC Insulation System Electrical Evaluation on Small Scale Samples and Model Cables**

Marc BAILLEUL1, Ramona HUUVÄ2, Johan ANDERSSON2, Anette JOHANSSON2
1BOREALIS N.V., Belgium; 2BOREALIS AB, Sweden
Harnessing solar-wind complementarity to unlock the full potential of submarine high voltage cables: a case study for the Belgian North Sea
Oscar DELBEKE, Johan DRIESEN
KU Leuven

Sustainable Circular Solutions for Cables with XLPE Insulation System
Paul BRIGANDI1, Maria MOUBARAK2, Edit BERCZI3, Saurav SENGUPTA4
1Dow, United States of America; 2Dow Deutschland, Germany; 3Dow Europe GmbH, Switzerland; 4University of Delaware, United States of America

Positive Impact of Novel XLPE on both Performance and Sustainability
Timothy PERSON1, Roshan AARONS2, Edit BERCZI3, Saurav SENGUPTA1
1Dow, United States of America; 2Dow, Germany; 3Dow, Switzerland

Design for sustainability (D4S)
Alberto BAREGGI
PRYSMAN GROUP, Italy

Development of GIS Cable Termination with improved Compactness and Compatibility towards SF6 alternative Gases
Lei CHEN
NKT AB, Sweden

On-site testing and 1-year operational experience for 145 kV, 2500 A pressurized air insulated cables
Marcel STOECKLI1, Walter HOLHAUS2, Zeljko TANASIC3, Raphael LUETHI4, Jasmin SMAJIC1
1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2Hivoduct AG, Switzerland; 3ETH Zurich Institute of Electromagnetic Fields, Switzerland

Towards innovative solutions to connect HVDC cables with less potential environmental impact
Espen DOEDNES1, Nils-Bertil FRISK2, Abdellatif Ait AMAR2
1Nexans Norway AS Norway; 2Nexans S.A. France
Enhanced HV Cable Connection Alarm System: Introducing i-LinkBox™
Sadettin ERDENIZ, Yusuf HIZAL
EM Elektrik-EMELEC Türkiye

Development of replacing method from HPFF cable to XLPE cable system sustaining old steel pipe
Yusuke MURAKAMI1, Fumihiko TAKI2, Kimihiro IWASAKI2, Takuto KOBAYASHI2, Makoto SUIZU3, Ryu MATSUO4
1TEPCO Power Grid, Incorporated, Japan; 2TEPCO Holdings, Incorporated, Japan; 3Sumitomo Electric Industries, Ltd., Japan; 4STEC, Japan

Design process for the assessment of currents distribution and ampacity on high loaded 36 kV links with multiple cables per phase
Enrico DI VITO, Paolo FALESSI, Lorenzo GARZELLI, Luca GUIZZO
Terna SpA

B2 - OVERHEAD LINES
PS1 - CHALLENGES FROM RENEWABLES INTEGRATION AND INFLUENCES OF ENERGY TRANSITION ON OHL

Application of Phase-to-phase Spacers in Prevention and Control of Ice-Shedding on Compact Transmission Lines
Zenghao HUANG1, Hao LI1, Lingmeng FAN1, Linjie ZHAO1, Qi YANG2, Hao PAN2
1China Southern Power Grid Research Institute Co., Ltd., China; 2Electric Power Science Research Institute of Yunnan Power Grid Co., Ltd., China

HVDC overhead line insulators: basics and performance
Jean-Marie GEORGE, Damien LEPLEY
Sediver, France

Double circuits overhead lines DC + AC: focus on EMF of the pilot project 500kV DC + 132kV AC
Andrea PIGNATA
TERNA, Italy

The new 500 kV HVDC Italian Overhead Lines
Gabriele TRESSO
TERNA, Italy
ID: 10361
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

5-phases solution and series compensation: a cost-effective strategy for OHLs power transfer capacity increase under stability margin
Michela MIGLIORI
TERNA, Italy

ID: 10522
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL
Keywords: Overhead lines, induced currents, temporary earthing, portable earthing device, arcing

Considerations for temporary earthing in compact and heavy loaded OHL
Ebbo DE MEULEMEESTER1, Ranjan BHUYAN2, Dhruvi SHUKLA1, Pragati KIDAMBI1, Chris ENGELBRECHT1
1DNV; 2TenneT TSO; 3DNV / Technical University of Delft

ID: 10574
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL
Keywords: Overhead Lines, Uprating, HTLS conductor, Tower Reinforcement, Conductor Selection

Design Challenges and Recommendations in Uprating the Existing 380 kV Overhead Lines, The Netherlands
Tom BÖRGER1, E. PLATENKAMP2, Jeff BROWN2, Renata GHENO1
1DNV; 2TenneT TSO

ID: 10613
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL
Keywords: Latticed Tower, Corrosion, Thickness losses, Damage profiles

Substitution of Angles in Latticed Towers of Maracaibo Lake
Carlos J. GARCIA ALAMO
RRC Companies LLC

ID: 10620
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL
Keywords: Energy transition, regional interconnections, transmission line optimization, compacting, bundle expansion, Surge Impedance Level (SIL)

500 kV Paranaiba OHL - A HSIL line with high transmission capacity: Design, construction and performance report
Luiza Lemos Nogueira MARTINS, João Batista Guimarães Ferreira DA SILVA, Ricardo ANDRADE, Ronaldo COELHO
Brazilian NC of CIGRE, Brazil; Paranaiba

ID: 10766
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL
Keywords: remote monitoring, power transmission capacity of OHLs, wire state

Increasing Power Transmission Capacity of OHLs via Continuous Real-time Remote Monitoring of Wire State
Mikhail PANARIN, Viktor TOKAREV
ServiceEnergy Ltd, Russian Federation

ID: 10790
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL
Keywords: remote monitoring, power transmission capacity of OHLs, wire state

Maximizing power transfer and RES integration using Dynamic Line Rating (DLR) - Ireland TSO experience
Kingsuk SAHA1, Derek CARROLL1, Andrew MCGRATH1, Aidan GEGHEGAN1, Dag DREJER2, Vemund LOSNEDAL3, Aran STOKES1
1EirGrid; 2ESB Networks; 3Heimdal Power

ID: 10900
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Maximizing power transfer and RES integration using Dynamic Line Rating (DLR) - Ireland TSO experience
Kingsuk SAHA1, Derek CARROLL1, Andrew MCGRATH1, Aidan GEGHEGAN1, Dag DREJER2, Vemund LOSNEDAL3, Aran STOKES1
1EirGrid; 2ESB Networks; 3Heimdal Power

Rohit TRIVEDI, Chittesh CHANDRAN

EirGrid

Evolution, State of the Art and Future Development Trends in Composite Insulated Cross-arm Technology

Usama AHMED1, Eric MOAL3, Xinlong WANG2, Yanlin Li2, Jie Yu2, Liu CHAO2

1SHEMAR, Canada; 2SHEMAR, China; 3SHEMAR, France

Predicting Capacity Gains from Dynamic Line Rating prior to Sensor Deployment

Tobias AASPRONG, Gunnhild SVANDAL PRESTHUS

Statnett Norway

Efficacy of introducing a DLR system for the operation of an overhead line connected with high power photovoltaic facilities

Tomoki KITASHIMA1, Yves BRUSTEN2, Daisuke SAITO1, Brian BERRY3, Jonathan MCGINNIS2, Laurent GERLACHE3

1Furukawa Electric Power Systems, Co. Ltd., Japan; 2Ampacimon S.A., Belgium

Finite Element Analysis of a Jumper Conductor Set used in Power Transmission Towers under Wind Effect

Burak Talha KILIC1, Eray BARAN1, Mete UZAR1, Orhan DEMİR RHAN1, Berat BILGIN1, Ibrahim EZER2

1Middle East Technical University Türkiye; 2Turkish Electrical Transmission Corporation (TEİAŞ) Türkiye

Audible Noise and Radio Interference Constraints for Hybrid Conversion of Existing EHV AC Overhead Lines: Mexican and Italian Case Studies

Francesco PALONE1, Carlos TEJADA-MARTINEZ2

1Terna SpA, Rome, Italy; 2Instituto Politécnico Nacional (IPN), México

Noise-reducing conductors for reconductoring projects

Jeremy UNTERFINGER, Stefan STEEVENS, Saskia MÖLLENBECK, Benjamin SCHRÖDER, Steffen RIEBLING

Amprion GmbH, Germany

Voltage Uprating of 275 kV Overhead Transmission Lines to 400 kV with Retrofit Insulated Cross-arms (RICA)

James DEAS1, Usama AHMED1, Xinlong WANG1, Yanlin Li1, Tange Teh PT3, Alfredo FERNANDEZ1, Bahare HASSANIPOUR2

1National Grid UK; 2SHEMAR Canada; 3SHEMAR China; 4SHEMAR UK; 5SHEMAR Spain; 6Wood plc UK
ID: 11177
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Improved Model for Overhead Line Audible Noise Prediction
Oliver PISCHLER¹, Uwe SCHICHLER¹, Isobel GREEN², Azeez AJIBOLA²
¹TU Graz; ²SSEN Transmission

ID: 11192
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Sustainable Transmission Innovation with Poles, Cables, and Insulators -TRIPI-Study Case in Urabá, Colombia
Jhoinner OSORIO, Diego TAUTA
EPM

ID: 11199
B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Optimization Algorithm for Transmission Line Routing with Multicriteria Constraints
Anderson VELANDIA¹, Cristian MENDOZA¹, Fernando DINIZ², Judy VALVERDE¹, Wallace HONORATO²
¹Enlaza Grupo Energia Bogotá; ²Argo

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B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Wind speed measurement at the conductor for exact ampacity calculation for overhead power lines
Wolfgang FRÖB¹, Carsten BROCKMANN², Andreas HORETH¹, Alexandra KRAEMER³
¹LTB Leitungsbau GmbH, Germany; ²Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM, Germany; ³BKW ES, Germany

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Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

First HV DC links in KSA OHL networks, conductor design, DC loss studies, manufacturing and testing
Mohamad EL CHMOURI
RIYADH CABLES GROUP, KSA

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Turning Cold Deserts of India into Solar Energy Powerhouse by Developing a Transmission system Through Snow Cladded Mountains
Karanvir Singh PUNDIR, Nitesh KUMAR, Dr. Subir SEN, Rajesh GUPTA, Abhay CHOUHARY
Power Grid Corporation of India Limited, India

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B2 OVERHEAD LINES - Full Papers
Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Parallel Giants: The Twin Steel Monopoles in Heart of National Capital Region
Shrikant G. GAJBHE*, Nitesh Kumar SINHA, Rajesh Gupta GUPTA, Dr. Subir SEN, Abhay CHOUHARY
POWERGRID CORPORATION OF INDIA LIMITED INDIA, India

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Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Innovative Solution & Construction Technique For Cable Termination Arrangement for Transmission Line Towers
Rahul PURI*, Nitesh Kumar SINHA, Rajesh Gupta GUPTA, Dr. Subir SEN, Abhay CHOUHARY
Power Grid Corporation of India Limited, India

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Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

Rock bolting raft foundation of a Long span Narrow based terminal tower for Lower Subansiri Hydropower project – POWERGRID Experience
Pradeep PALANISAMY*, Neeraj Singh GAUTAM, Nitesh Kumar SINHA, Rajesh Gupta GUPTA, Dr Subir SEN, Abhay CHOUHARY
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DESIGN CONSIDERATIONS & ROUTE SELECTION FOR WORLD’s HIGHEST ALTITUDE +/-350 kV MULTIPOLE HVDC TRANSMISSION LINE
Ashish SINGH, Nikhil JHA, Chandra KANT, Anil SHARMA, Rajesh KUMAR
POWERGRID CORPORATION OF INDIA LIMITED, India

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IMPLEMENTATION OF NEW GENERATION HTLS CONDUCTORS ON EXISTING TRANSMISSION LINES CONTRIBUTING TO LOW COST AND CARBON NEUTRALITY SOLUTION–POWER GRID EXPERIENCE
Subhash C TANEJA1, M L SACHDEVA2, N S SODHA1
1Ex-Power Grid Corporation of India, India; 2Ex-Central Electricity Authority, India

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Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

A STUDY ON THE NEW ADJUSTMENT DEVICE TO ADJUSTING A SAGGING OF WIRES FOR OVERHEAD LINES
Heejeong YU, Kyunghun LEE, KiHyun JO, Jongchae KIM
KEPCO, Korea, Republic of (South Korea)

ID: 11615
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PASSIVE ASSET ACTIVATION THROUGH A MEASURING SYSTEM BASED ON FIBER OPTICS IN CONTEXT OF ASSET MANAGEMENT, STRATEGIES, TECHNOLOGIES AND METHODS FOR OHL
Franziska GEBHARDT1, Roman SIMKIN1, Uwe ZIEBOLD1, Dirk KUNZE1, Dennes MENTZ2
150 Hertz Transmission GmbH, Germany; 2WG SYSTEMS e.K., Germany

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DEVELOPMENT OF DESIGN RULES FOR THE USE OF NEW HIGH-STRENGTH STEELS FOR LATTICE TOWERS
Jan MAESSCHALCK1, Sofia ANTONODIMITRAKI1, Marios-Zois BEZAS2, Jean-François DEMONCEAU2, Muhammad Omer ANWAAR3
1ELIA ENGINEERING, Belgium; 2UNIVERSITY OF LIEGE, Belgium; 3ARCelor-MITTAL, Luxembourg

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Topics: B2 PS1 - Challenges from Renewables Integration and Influences of Energy Transition on OHL

KEY CHALLENGES OF DESIGN & CONSTRUCTION IN CREEK AREA OF 765 kV D/C HEXA CONDUCTOR BASED LAKADIA VADODARA TRANSMISSION PROJECT
Chandan KALRA*, Harish KUMAR*, Prem KUMAR, Rajesh SURI
Sterlite Power Transmission Limited, India

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EMISSION-FREE ELECTRIC DRUM WINCH eST 140
Michael ERSPAMER2, Gisela GRUBER1, Ulrich OTTERMANN2
1Zeck GmbH, Germany; 2Omexom Hochspannung GmbH Zeck GmbH, Germany; 3TenneT TSO GmbH
Influencing parameters of the electrical-thermal long-term behaviour of current-carrying fittings under outdoor conditions

Christian HILDMANN1, Markus Andreas GöDICKE1, Stephan SCHLEGEL1, Jérémy UNTERFINGER2
1TU Dresden, Germany; 2Amprion GmbH, Germany

Optimal routing of corridors and paths of OHL for grid connectivity and substation siting with improved stakeholder engagement

Marcel STOECKLI1, Stefano GRASSI1,2
1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2GILYTICS AG, Switzerland

Navigating Uncertainties in Dynamic Line Rating Estimation

Brian LEIST, Kristine ENGEL, Josef SPALENKA, Clay WATERS, Rachael GRUDT, Nathan PINNEY, Jon MARMILLO
LineVision Inc.

Dielectric testing for integrity assessment of overhead composite core conductors

Léo RICHARD
Epsilon Composite Cable, France

Damage in overhead lines – A tool for lifespan prediction

Julien SAID1, Emmanuel CIEREN2, John REFORD2, Maxime GUEGUIN2, Rémi CAPILLON2, Matthieu ANCELLIN2
1RTE, France; 2Eurobios, France

A Forest Fire Target Detection Method Based on YOLOv8

Yuanjun ZUO, Zhihong HUANG, Yunlong SUN, Jian XIAO, Sheng WU
State Grid Hunan Electric Power Company Limited Research Institute, China

Analysis of lightning strike distribution of typical 500 kV transmission lines based on lightning data and distributed transient traveling wave

Shanghai GU, Yingpu XIE, Jian LI, Min WU, Mengfei LEI, Xiaoqin ZHANG
State Grid Electric Power Research Institute, China
Diagnostic analysis and suggestions for batch heating of composite insulators of 500 kV overhead lines in central China

Yijun YUAN¹, Zixin ZOU², Peng ZENG¹, Yafeng CHAO¹, Peng JIANG³
¹State Grid Hunan Electric Power Company Limited Research Institute, China; ²State grid Hunan Changsha power supply company, China; ³State grid Hunan Hengyang power supply company, China

Experimental Study on the Characteristics of Grounding Devices for Towers of Overhead Transmission Line

Bo ZHANG¹, Sen WANG², Shanzhong GU³, Zhizhong LI², Yingpu XIE³
¹Tsinghua University, China; ²Shaanxi Electric Power Research Institute, China; ³State Grid Electric Power Research Institute, China

Lightning Risk Assessment Method for Transmission Channel Based on EGM and Numerical Solution

Shanzhong GU, Mengfei LEI, Jian LI, Min WU, Hua REN, Yingpu XIE
Wuhan NARI Limited Company, State Grid Electric Power Research Institute, China

Study on the Fatigue Fracture Mechanism of Transmission Line under Breeze Vibration Considering the Influence of Splicing Sleeve

Chuanbin LIU¹, Chao ZHOU¹, Hailei MENG¹, Jun YONG¹, Hui LIU¹, Ao MEP¹, Xiaohui LIU²
¹State Grid Shandong Electric Power Company, China; ²Chongqing Jiaotong University, China

Test bench and database for ACSR cable non-destructive testing

Pascale PRIEUR¹, Stéphane HEURTAULT¹, Louise EYMARD-AUPHIN¹, Julien SAID¹, Jean-Philippe SAUT², Kieu-Diem HO²
¹RTE, France; ²EUROBIOS, France

Quantitative Framework for Estimating the Depth of Wind-induced Wear at Connections on Overhead Lines

Gitanjali BHATTACHARJEE, Brian MCDONALD
Exponent, Inc., United States of America

Conductor Icing Risk Assessment and Detection with Weather and Position Monitoring

Kristine ENGEL¹, Shikhar PANDEY², Rachel GRUDT¹, Will NATION²
¹LineVision, Inc., United States of America; ²Commonwealth Edison Company, United States of America

AI-Enabled Transmission Line Inspections

Zefan TANG, Jing YANG, Junhui ZHAO, Elizabeth HALL, Asim FAZLAGIC
Eversource Energy, United States of America
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<td><strong>Risk-based after-service Inspections and Testing of overhead Line Composite and Porcelain Insulators for residual Life Assessment</strong></td>
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<tr>
<td>Igor GUTMAN¹, Johan LUNDENGÅRD¹, Matthew HEATH², Charles KURNIAWAN²</td>
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<td>¹Independent Insulation Group Sweden AB; ²Transgrid Australia</td>
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<td><strong>Decision Support Center with Muti-sensory Data for Infrastructure Protection</strong></td>
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<td>João GASPAR¹, Luis Mário RIBEIRO², José MOREIRA¹, Carlos VIEGAS², Pedro MARQUES¹, David ALMEIDA²</td>
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<td>¹REN - Redes Energéticas Nacionais, SGPS, S.A.; ²Univ Coimbra, ADAI, Department of Mechanical Engineering</td>
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<td><strong>Defect Analysis of Polymeric High Voltage Insulators: Condition Assessment and Inspection Techniques</strong></td>
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<td>André COELHO¹, Gonçalo PINTADO², Pedro NUNES¹, Rui MARTINS¹</td>
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<td>¹EDP Labelec, Portugal; ²REN, Portugal</td>
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<td><strong>On the assessment of electromagnetic interference of overhead lines and underground cables on gas pipelines</strong></td>
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<td>Andreia LEIRIA, João TARQUÍNIO, António ESTEVES</td>
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<td>¹Instituto Tecnológico de la Energía, Spain; ²Red Eléctrica, Spain; ³Universitat Politècnica de València, Spain</td>
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<td>¹Red Eléctrica, Spain; ²Elewit, Spain; ³Redeia, Spain; ⁴AOS, Spain; ⁵Amplia, Spain</td>
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<td><strong>Experience with Satellite Imagery for Maintenance of OHL Lines</strong></td>
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<td>Emanuel DE BOE¹, Görg Philip MAXIMILIAN², William VAN DEN BROECK¹, Irid BUFI²</td>
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<td>¹ELIA, Belgium; ²50 hertz, Germany</td>
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<td><strong>Influence of Acid Attack on the Hydrophobicity of HTV Silicone Rubber on Composite Insulators</strong></td>
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<td>Marcel STOECKLI¹, Jaka STRUMBELJ², Yannick INDERBITZIN³, Urs GASSER³, Christine BAER³</td>
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<td>¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Pfisterer Switzerland AG, Switzerland; ³Wacker Chemie AG, Germany</td>
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Combined Effects of Audible Noise Mitigation Measures for OHLs by Surface Treatments and Enlargement of Conductor Diameter

Marcel STOECKLI¹, Hannah KIRCHNER¹,², Christian FRANCK³, Benjamin SCHROEDER³
¹ELECTROSUISSE, Switzerland; ²CIGRE NC Secretariat; ³ETH Zurich, Switzerland; ⁴Amprian GmbH, Germany

Monitoring Overhead Lines through images from nanosatellites

Carlos NASCIMENTO¹, Thiago MUNIZ², Demetrio AGUIAR², Valter SILVA¹, Guilherme BRANGIONI¹, Lucas SOUZA¹
¹Brazilian NC of CIGRE, Brazil; ²Cemig GT

Atmospheric weathering and corrosion, in a tropical country such as Brazil, in the maintenance costs of metallic materials in power transmission lines

Fernando DINIZ¹, Euro PINTO DE ALMEIDA¹, Thiago Luiz FERREIRA¹, Alberto RODRIGUES DE SOUSA¹, Camila PACHER², Julia Stefany ALBRECHT³, Mariana BRAGANÇA¹, Kleber PORTELLA¹, Juliano DE ANDRADE¹, Bruno KOWALCZUK³, Mauricio MAZUR³
¹Brazilian NC of CIGRE, Brazil; ²Consultor; ³LACTEC

Characteristics of Outdoor Insulation in Areas with Different Natural and Climatic Conditions, Types of Environment and Sources of Pollution

Lev VLADIMIRSKII, Olga SUSLOVA
JSC NIIP, Russian Federation

Multiphysics OHL modeling

Aleksandar TERZIĆ, Nebojša PETROVIĆ
Elektromreža Srbije JSC, Serbia

Hyperspectral Imaging for the Corrosion Detection on Metallic Lattice Towers

Frédéric MANGIALETTO¹, Irid BUFI², Mohring WENCKE², Eveline VRANKEN¹, Roeland VANDEBRIEL¹, Michiel VLAMINCK², Zakaria BNOULKACEM³, Mina ZAHIRI³, Gonzalo LUZARD³, Hiep LUONG³
¹ELIA, Belgium; ²50Hz, Germany; ³Imec, Belgium

High temperature low sag conductors in high ice load regions

Vivendhra NAIDOO¹, Bjarni Helgi THORSTEINSSON², Kjell Age HALSAN²
¹EFLA Consulting Engineers Norway; ²Statnett Norway
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<td>Hayato SANO, Motoyuki YAMAZAKI, Yoshiyuki SAITO, Tomoaki OSONO, Keito MURAKAMI, Tomonori SHIRAISHI</td>
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<td><strong>Development of steel tower reinforcement method using flat bar and steel tower repair method using carbon fiber</strong></td>
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<td><strong>Development of automated inspection technology for overhead transmission lines using drones</strong></td>
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<td>Fumihiko KONDO1, Yuki MARUME1, Takaya MASUDA1, Masahiro OGAWA2, Kentaro FUKAMI1, Erika TANAKA2</td>
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<td><strong>Field Experience and Maintenance Assessment of RTV Coated Cap and Pin Insulators in Japan</strong></td>
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<td>Ryo YUZAWA1, Asuka TOKURIKI1, Motohiro MAEDA2, Toshiyuki NAKACHI2</td>
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<td><strong>Mechanism Clarification of Insulating Performance Decreasing by Aging of Polymer Insulators for Overhead Transmission Lines</strong></td>
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<td>Teruhisa TATSUOKA1, Toshihiro TSUBOI1, Hiromitsu IJICHI2, Tatsuya ISHIKAWA2, Sakea TANIGUCHI2, Tomonori SHIRAISHI2</td>
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<td><strong>Keywords:</strong> asset health index, mechanical stresses, temperature influence, tower, vibration</td>
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<td><strong>Asset Health Index for Towers and Conductors in the Framework of EU Project FARCROSS</strong></td>
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<td>Viktor LOVRENCIC1, Nenad GUBEJAK1, Bálint NÉMETH2, Matej KOVAČ4, Levente RACZ2, Ana LOVRENCIC4</td>
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<td>1C&amp;G Ljubljana, Slovenia; 2Faculty of Mechanical Engineering, Maribor, Slovenia; 3BME Budapest, Hungary; 4GRIDPULSE Ljubljana, Slovenia; 5BME Budapest, Hungary; 6C&amp;G Ljubljana, Slovenia</td>
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<td>1Aurecon, Australia; 2Transgrid, Australia</td>
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B2 OVERHEAD LINES - Full Papers
Topics: B2 PS2 - Asset Management, Strategies, Technologies and Methods for OHL

Insulator set cold end fitting failures: understanding failure mechanisms and prioritizing replacements
Andreas LEM1, Michael WILSON2
1Groundline Engineering, Australia; 2Transpower, New Zealand

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Impact of Bushfire on Conductor Performance - Prioritising Rectification Works
Matthew HEATH1, Charles KURNIAWAN1, Brendan SHANAHAN1, Tim MACPHERSON2, Denis DOWLING2
1Transgrid, Australia; 2Raedyne Systems, Australia

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New Precautionary Studies and Results for Reducing Bird Caused Faults in Over Head Lines
Muhammet Furkan YILMAZ1, Ali OZTURK2, Murathan YENICELI1, Ümit AKTAS1
1Turkish Electrical Transmission Corporation (TEIAS) Türkiye; 2Düzece University Türkiye

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Verification with Grounding Models and Field Performances Developed in the CDEGS Program for High Voltage Power Transmission Poles
Mustafa TASCI, Bilgehan TEKŞUT, H. Can CIVAN, Burak Cem KARABAG
Turkish Electrical Transmission Corporation (TEIAS) Türkiye

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Topics: B2 PS2 - Asset Management, Strategies, Technologies and Methods for OHL

Wind induced acoustic emissions on glass insulators
Carina LINTNER1, Oskar OBERZAUCHER1, Michael LEONHARDSBERGER1, Fabien VIRLOGEUX2
1Austrian Power Grid AG; 2Sediver S.A.S.

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Incorporation of New Technologies (drones) in the Maintenance and Monitoring of the Condition of High-Voltage Transmission Lines in ISA-INTERCOLOMBIA
Natalia RESTREPO, Carlos PUELLO, Juan PEÑA
ISA Intercolombia

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Johanna RODRIGUEZ1, Juan MARTINEZ2, Jady UPEGUI1
1Enlaza Grupo Energía Bogotá; 2Trecsa

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Topics: B2 PS2 - Asset Management, Strategies, Technologies and Methods for OHL

Analysis of Electrical Risks by Electromagnetic Induction on Parallel High Voltage Overhead Transmission Lines
William Gonzalo FLORES RUIZ1, Carlos Roberto TAPIA FARFAN2
1National University of Engineering, Peru; 2ISA REP
| ID: 11230 | B2 OVERHEAD LINES - Full Papers | The use of drones for preventive maintenance of high voltage transmission lines: business case and field experiences |
| ID: 11314 | B2 OVERHEAD LINES - Full Papers | Towards a Digital Twin for Management of OHL Risk |
| ID: 11353 | B2 OVERHEAD LINES - Full Papers | Power System Management based on Distributed Line Monitoring |
| ID: 11383 | B2 OVERHEAD LINES - Full Papers | Autonomous Inspection and Fault Detection of Transmission Line Component Based on Unmanned Arial Vehicle (UAV) |
| ID: 11471 | B2 OVERHEAD LINES - Full Papers | Assessment of Operating Life of Silicone Rubber HV Insulator Coatings in Harsh Desert Environment |
| ID: 11504 | B2 OVERHEAD LINES - Full Papers | Use Of Convolutional Neural Network For Defect Identification From Tower Images And Unsupervised Machine Learning Algorithms For Transmission Line Vulnerability Estimation |
Comprehensive Rectification Methodology for Submerged Pile Foundation of Overhead Transmission Line Towers
Pankaj Kumar DWIVEDI, Nitesh Kumar SINHA, Rajesh GUPTA, Dr. Subir SEN, Abhay CHAUDHARY
Power Grid Corporation of India Limited, India

Transforming Transmission Line Surveys: An Innovative AI-Based Optimization Approach
Neeraj Singh GAUTAM*, Priti NAHAR, Rajesh GUPTA, Dr. Subir SEN, Abhay Chaudhary CHAUDHARY
Power Grid Corporation of India Limited, India

Residual Life Estimation of Overhead Transmission Lines based on Asset Health Indexing
Devaprasad PAUL*, Joseph George JOSE, Deo Nath JHA, Kuleshwar SAHU
POWERGRID, India

Implementation of AHI for risk-based asset management approach on overhead lines and the strategic value towards transmission grid
Franziska GEBHARDT, Roman SIMKIN, Andre DECKWERTH, Dirk KUNZE
50 Hertz Transmission GmbH, Germany

Use of Gantries as Medium-Term Support to Ensure Continuity of Service for OHL After Severe Structural Damage in an Impact Incident
Jan MAESSCHALCK1, Kris NUYTS2
1ELIA ENGINEERING, Belgium; 2SARENS, Belgium

The Innovative Project “ALTITUDE” - Automatic aerial Network inspection using Drones and Machine Learning
Georgios CHATZARGYROS1, Vasiliki KOTOUNA1, Evangelia RIGATI1, Dimitrios STIMONIARIS2, Dimitrios TSIAMITROS2, Apostolos PAPAKONSTANTINOU2, Argyrios MOUSTAKAS2, Dimitrios SIMOS2, Georgios LOUKOS3, Sotiris CHRISTOPoulos3, Georgios DOUKAKIS3, Konstantinos MARIOLIS3, Konstantinos KAOUSSIS4
1Renel I.K.E, Greece; 2INNORA, Greece; 3SciDrones, Greece; 4Hellenic Electricity Distribution Network Operator (HEDNO), Greece

Advanced Overhead Power Lines Electric Field and Stationary AC Corona Analysis Utilizing Artificial Intelligence
Adnan MUJEZINOVIC, Ajdin ALIHODŽIĆ, Emir TURAJLIĆ, Maja MUFTIĆ DEDOVIĆ, Zijad BAJRAMOVIĆ
University of Sarajevo - Faculty of Electrical Engineering, Bosnia and Herzegovina

Route Planning System of Overhead Transmission Lines Utilizing Helicopter Measurement Data
Atsunori ISHIKAWA1, Tomoya FUNATO2
1Kansai Transmission and Distribution, Inc.; 2AERO ASAHI CORPORATION
Probabilistic Assessment of the Residual Life of Overhead Conductors Under Aeolian Vibrations
Shaoqi YANG¹, Luc CHOUINARD¹, Sébastien LANGLOIS², Pierre VAN DYKE³, Josée PARADIS¹
¹McGill University; ²Université de Sherbrooke; ³Institut de recherche d’Hydro-Québec

Dielectric testing for integrity assessment of overhead composite core conductors
Léo RICHARD
Epsilon Composite Cable

Investigation of audible noise emissions from corona discharges of single water droplets on different surfaces under AC stress
Yang LU, Christian FRANCK
ETH Zurich

Analysis of ice shedding induced faults of multiple voltage levels overhead lines and its mitigation strategies
Kunpeng JI, Bin LIU, Jialun YANG
China Electric Power Research Institute, China

Design and experimental analysis of arrester for ± 800kV UHVDC OHL
Shanjian GU¹², Wei CAO¹², Jian LI¹², Shuai WAN¹², Jian WANG¹
¹Wuhan NARI Limited Company, China; ²State Grid Electric Power Research Institute, China; ³State Grid Corporation of China, China

Development of Galloping Distribution Maps for Overhead Transmission Lines with Specific Return Period in China
Jialun YANG, Bin LIU, Bin ZHAO, Yi LIU, Zhiyuan LU
China Electric Power Research Institute, China
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<td>Ben GEORGIN1, Matt BOWERS1, Alex HUDGINS1, Hunly CHY2, Arianne LUY2</td>
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Investigation of the future development of temperature and low wind velocity in climate change for the Austrian power grid

Kerstin WEINDL¹, Klemens REICH¹, Hans RESSL², Theresa SCHELLANDER-GORGAS³, Max NUTZ²
¹Austrian Power Grid; ²Geosphere Austria

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Topics: B2 PS3 - Impacts from Climate Change on OHL

Deficiencies in the IEEE 1138 Standard for the Specification of an OPGW Cable Against Atmospheric Discharges

Yasert PEREZ, David GOMEZ, Juan MAYA
ISA Intercolombia

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Topics: B2 PS3 - Impacts from Climate Change on OHL

Satellite Images as a Tool for Risk Management in Transmission Lines: Results of a Pilot with Emphasis on Landslides

Alexander BEDOYA, Mallory SUAREZ
ISA Intercolombia

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Topics: B2 PS3 - Impacts from Climate Change on OHL

Influence of transient impedance due to atmospheric discharges in the design of grounding of transmission towers

Hugo Eduardo BARREDA SÁNCHEZ
Redinter - Redeia

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Measures to mitigate effect of cyclone on the transmission line structures

Karanvir Singh PUNDIR*, Nitesh Kumar SINHA, Rajesh GUPTA, Dr. Subir SEN, Abhay Choudhary CHAUDHARY
Power Grid Corporation of India Limited , India

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Topics: B2 PS3 - Impacts from Climate Change on OHL

Climate change and its associated materials requirements

Franziska GEBHARDT¹, Milad MEHDIANPOUR², Wencke MOHRING¹, Jan MAESSCHALCK³, Jan KNACKMUß¹, Dirk KUNZE¹
¹50 Hertz Transmission GmbH, Germany; ²IPU Ingenieurgesellschaft Berlin mbH, Germany; ³Elia Engineering, Belgium

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Impact Of Climate Changes on Designing of New Overhead Transmission Lines: Experiences from the Croatian Transmission System Operator

Goran LEVAČIĆ, Igor LUKAČEVIĆ, Krešimir MESIĆ, Mate LASIĆ, Igor IVANKOVIĆ
HOPS* Croatia
Next Generation Distribution Center in a Box (DCIAB)
Kushal SINGH, Jose MITRA, Sean FITZGERALD
Exelon/ComEd, United States of America

Small Modular Reactor and Hydrogen Production: “Impacts on Substation Design”
George W. BECKER
POWER Engineers, Inc., United States of America

Conceptual Design of Semi-submersible Floating Offshore HVAC Substation Solution
Hongbiao SONG1, Zhaoxiang TANG3, Yang OUYANG3, Robert LUESCHER2, Tobias STIRL4, Hana ASSEFA2
1GE Vernova Grid Solutions, United States of America; 2GE Vernova Grid Solutions, Norway; 3GE Vernova Grid Solutions, Switzerland; 4GE Vernova Grid Solutions, Germany; 5Genesis Technip Energies, United States of America

The 36 kV voltage level – a new standard solution for grid integration of renewable energy sources
Andrea VALANT
TERNA, Italy

GIS for offshore and floating applications
Marcel STOECKLI1, Yang OUYANG2, Lukas TREIER2, Bernhard SPICHIGER2, Robert LUESCHER2, Hongbiao SONG3
1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2GE Vernova, Switzerland; 3GE Vernova, USA

420 kV SF6-free High Voltage Gas Insulated Switchgear Design, Type Tests and Product Footprint
Marcel STOECKLI1, Vincent TILLIETTE2, Navid MAHDIZADEH2, Ueli STRAUMANN2, Patrick STOLLER2, Denis TEHLAR2, Kalpesh CHAUHAN3
1ELECTROSUISSE / CIGRE Switzerland NC Secretary; 2Hitachi Energy Ltd, Switzerland; 3Hitachi Energy Ltd, India

First Step toward Carbon Neutrality using BESS Project in South Africa
Jung Bae KIM, Minsoo LEE
Hyosung Heavy Industries
The role of increased standardisation in the delivery of substation infrastructure to enable a low carbon future in Ireland

Hugh CUNNINGHAM, Ivan CODD, Enda HARRINGTON, Brendan LINEHAN, Bernard O’SULLIVAN, Colm TWOMEY
Electricity Supply Board (Ireland)

Experience with HVDC GIS application during commissioning and early operation phase

Maria KOSSE1, Christoph KLEIN1, Maximilian TUCZEK1, Frank Rene RICHTER1, Thomas GÖTZ1
1Siemens Energy Global GmbH & CO. KG, Germany; 2TenneT TSO GmbH, Germany; 350Hertz Transmission GmbH, Germany

New test and commissioning tools and concepts for Low Power Instrument Transformers

Franz GATZE2, Peter MENKE1, Patrick MORITZ1, Federico CANAS2, Max BUROW1, Joerg BLUMSCHEIN2, Antoni Furlani ROSA2, Lucas VARELA2, Thomas NEUMEIER2
1Siemens Energy, Germany; 2Siemens AG, Germany; 3SecuControl, Brazil

Offshore floating HVAC and HVDC substations – Experiences in design of selected primary equipment

Douglas RAMSAY1, Mark GEARY1, Thomas HAMMER2, Thorsten STEINHOFF2, Matthias STEUER2, Stephan VOSS2, Joerg HAHERMAAS1, Yana SHATEROVA1
1Corio Generation UK; 2Siemens Energy Germany

Optimization of overall HV cable length in hybrid transmission technologies used for evacuation of power from offshore wind parks/Solar parks by implementation of compact transition station.

BB MUKHERJEE, Sasikiran KANDALAM*, PNV Murali PRAKASH
Power Grid Corp. of India Ltd., India

EV Changing Infrastructure Design Challenges And Solutions – Case Study

Nilesh KANE, Ravindra BHANAGE*, Ajay POTDAR
TATA POWER, India

Challenges And Precautions During Design And Engineering Of Gas Insulated Switchgear (GIS) Substation Of Hydro Projects

Gorav VIG *, Sudhir KUMAR, Dileep SHUKLA, Vivek KAPIL, Aruna GULATI
BHEL, India

Novel Solution for Converting Existing 400kV I-Type One & a Half Breaker Scheme to D-Type for Evacuating Double Circuit Lines in Same Direction Using 3D Modelling

Nishant SINGH*, Vinay Anand ANAND, Sanjeev SHRIVASTAVA, Aruna GULATI
BHEL, India
Optimization Approach for the Layout design of 400/220kV Gas insulated Switchgear (GIS) Substations

Akhilesh KUMAR*, Aruna GULATI, Vivek KAPIL, Dileep K SHUKLA, Puneet CHAWLA
BHEL, India

Development of DC 320kV, 525kV GIS Cable terminations

Eui-hwan JUNG, Jin-ho NAM, Sung-yun KIM, Si-ho SON, Jung-nyun KIM
LS Cable&system, Republic of (South Korea)

Design and Considerations for Station Service Voltage Transformer (SSVT) to Provide Low-Voltage Supply in EGAT’s Substation

Koranee PHONGKHUMPHAI, Nabhat CHAIYAPHAN, Thanyathep NANTACHAI, Korракot WONGNIYOM, Pornpimon SAWADDEEMONGKON
Electricity Generating Authority of Thailand (EGAT), Thailand

PS2 - RETURN ON OPERATIONAL EXPERIENCES FOR SUBSTATION MANAGEMENT

In situ monitoring of the precision shift of capacitive voltage transformers

Bernard PAYA1, Alain JEANMAIRE1, Benoit BRUCHON2
1EDF R&D, France; 2EDF CIST-INGEUM, France

Solutions for temporarily increasing the Reliable Installation Capacity

François GEGOT1, Lars EBBERS2, Robert VOSSE3
1Wika, France; 2Qirion, Netherlands; 3Alliander, Netherlands

Synthesis of the different technologies for removing SF6 from medium voltage switchgear

Christophe PREVE1, Daniel PICCOZ2
1Schneider-Electric, France; 2SASU Daniel Piccoz, France

Integration, Operation and Maintenance of AIS Circuit Breakers using SF6 alternatives - experience with the 3 HV main technologies

Emmanuel LOPES1, Minh NGUYEN2, Benoit BRUCHON1, Fabrice MARETTE1
1EDF, France; 2RTE, France
Seismic Resilience of Interconnected Substation Equipment: Lessons Learned from a Comprehensive Test and Modelling Program
Leon KEMPNER, JR.1, M.V. SIVASELVAN2
1Bonneville Power Administration, United States of America; 2University at Buffalo, United States of America

Condition & Risk Assessment: Plans and Reality
Tony MCGRAIL1, Philip BOREHAM1, Jamie BEARDSALL4, Mark ROWBOTTOM5, Reena DHIR2, Carl JOHNSTONE5
1Doble Engineering, United States of America; 2Manitoba Hydro, Canada; 4I4 Asset Management, United Kingdom; 5Drax Power, United Kingdom

System Approach to Evaluation and Deployment of Substation Robotics
Poorvi PATEL1, Dean GORDON2, Sergo SAGARELI3, Dexter LEWIS1, Sunny BELLARY1
1Electric Power Research Institute (EPRI), United States of America; 2Con Edison, United States of America; 3Black & Veatch, United States of America

Evaluating and Comparing Substation Threat Mitigation Tactics: Substation Improvements for a More Resilient Power Grid
Paul SOMBOONYANON1, Connor BOWEN2
1AEC Lionstech, United States of America; 2Burns & McDonnell, United States of America

Overcoming Challenges and Progressing Electrical Substations toward Digital Transformation
Paul SOMBOONYANON1, Brian PALMER2
1AEC Lionstech, United States of America; 2Burns & McDonnell, United States of America

Monitoring System of Earth Loop Impedance to Verify Step and Touch Voltages
José R. VIDAL2, Abderrahim KHAMLICHI1,1, Antonio GONZALEZ2, José L. NAVARRO4, Pascual SIMÓN2, Fernando GARNACHO1
1Universidad Politécnica de Madrid, Spain; 2FFII-LCOE, Spain; 3EDP REDES ESPAÑA, Spain; 4UFD-GRUPO NATURGY, Spain

European Experience of Developing from Asset Reliability Information to Risk Method for Optimal Investment on Substation Assets
Jos SLANGEN1, Qikai ZHUANG2, Branislav PILAT3, Despoina MAKRIDOU4, Illic VLADIMIR5, Jan CERNOHORSKY6, Phillipe CLAUDE7, Mehdi OTHMANI7, Uros KERIN8
1TenneT TSO B.V.; 2TenneT TSO GmbH; 3SEPS; 4IPTO; 5EMS; 6CEPS; 7Rte; 8ELES
A system risk approach for management and optimization of critical spare parts

Marcel STOECKLI¹, Enrico CONTE², Sourav ADHYA³, Sakhthivel DURAIAPPAN⁴

¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Hitachi Energy, Switzerland; ³Hitachi Energy, Poland; ⁴Hitachi Energy, India

System for Real Time Monitoring and Optimising of Power Losses in High Voltage Substations - a Romanian Experience

Constantin MOLDOVEANU¹, Irene IONITA¹, Virgil BREZOIANU¹, Sorin ZAHARESCU¹, Ioan D HATEGAN², Mihai C MARCOLT³

¹Nova Industrial SA; ²Siemens Energy SRL; ³CNTEE Transelectrica SA

New Standards and Solutions for Service Continuity of HV GIS

Marcel STOECKLI¹, Jens HETTLER*², Mark KUSCHEL³, Samuel PACHLATKO⁴

¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Swissgrid AG, Switzerland; ³Siemens Energy AG, Germany; ⁴Hitachi Energy AG, Switzerland

Retrofit for 420 kV Gas-Insulated Lines: Technical Concept and Return of Experience

Marcel STOECKLI¹, Samuel PACHLATKO², Michael GATZSCHE³, Freddy VON ARX³, Manuel NAEF³, Francesco AGOSTINI³, Mark WALDRON³

¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Hitachi Energy, Switzerland; ³National Grid Electricity Transmission, United Kingdom

Implementation of the new IEC and CIGRE requirements on service continuity to high voltage gas insulated switchgear

Marcel STOECKLI¹, Samuel PACHLATKO², Denis TEHLAR², Josef HANSON³, Jennifer-RuiQiong PAN⁴, Benoit GODEAU⁵, Thomas WIJNHOVEN⁶, Nicolas DEMARTHE⁶

¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Hitachi Energy, Switzerland; ³Hitachi Energy, Germany; ⁴Hitachi Energy, China; ⁵Elia, Belgium

Digital twins applied for intelligent analysis and real-time monitoring of circuit breakers in electrical power substations

Ana MAROTTI¹, Giovani BERNARDES², Sergio SILVEIRA³, Clayton DUARTE PESSOA⁴, Gerson F. M. LIMA⁵, Clodualdo SOUSA⁶, Fabiano VILLANI⁷

¹Brazilian NC of CIGRE, Brazil; ²Eletrobras FURNAS; ³Computer Graphics Works; ⁴Eletrobras ELETRONORTE; ⁵Energia BIM; ⁶Eletrobras CHESF; ⁷Imagem Geosistemas; ⁸Computer Graphics Works
New Competencies and diagnostic Methods needed for the Application of Composite Insulators in Substations

Peter SIDENVALL
Independent Insulation Group Sweden AB, Sweden

The Impact of Digital Transformation on the Asset Management System

Dmitry VODENNIKOV¹, Yulia ZHILKINA¹, Svetlana ZAKIROVA¹
¹PJSC ROSSETI, Russian Federation; ²&T Centre of Rosseti FGC UES, Russian Federation

Experiences with commissioning of a 132 kV GIS SF6-free digital substation

Karl POLLESTAD¹, Jean-Luc RAYON², Christopher GEBS³, Hans Kristian MEYER¹, Asgeir MJELVE⁴, Jean-François MIRONNEAU¹, Assan SARR⁴
¹Bane NOR Norway; ²GE Renewable Energy France; ³SINTEF Energy Research Norway; ⁴Elvia Norway

Impact on Engineering and Lifetime Management of High Voltage Outdoor GIS

Toshiyuki SAIDA¹, Keisuke NAKAMURA³, Tobias ZIESEMER⁵, Jens KALLWEIT⁶, Manuel NAEF⁷, George BECKER⁶
¹Toshiba Energy Systems & Solutions Co., Japan; ²TEPCO Power Grid, Inc., Japan; ³Siemens Energy Global GmbH & Co. KG, Germany; ⁴GE Grid Solutions, Germany; ⁵Hitachi Energy, Switzerland; ⁶POWER Engineers, Inc., USA

Management experience of condition-monitoring system and development of new IoT devices

Yuki YATABE, Shinya AICH, Takayuki KANAMORI, Tetsuya IKEDA, Yusuke TAKENAKA
Chubu Electric Power Grid Co., Inc., Japan

Management of SF6 gas leakage and repair technology in gas insulated equipment

Keisuke NAKAMURA, Keisuke MURAKITA, Shigeyuki TSUKAO, Wataru ISHIKAWA, Harukazu AKIYAMA, Syuichi TAMURA
TEPCO Power Grid, Inc., Japan

Study on Advanced Maintenance Strategies and Asset Management for Substation Equipment in Japan

Kiyohiro TSUBOI¹, Shinya AICHI¹, Satoshi ICHIHARA¹, Kosho KAMATANI¹, Ryosuke ITOTANI¹, Koki SADAHIRO¹
¹Chubu Electric Power Grid Co., Inc., Japan; ²TEPCO Power Grid, Inc., Japan; ³Kansai Transmission & Distribution, Inc., Japan
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Ryosuke ITOTANI1, Koki SADAHIRO1, Masashi TOKAI1, Hiroyuki HAMA2, Kazuki SUGINO2, Manabu TAKEDA3

1Kansai Transmission and Distribution, Inc., Japan; 2Mitsubishi Electric Corporation, Japan; 3DAIHEN Corporation, Japan

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Hiroko ISAJI, Yousuke OGURA, Masanobu YOSHIDA

Chubu Electric Power Co., Inc., Japan

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Filip BENGTSSON

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Ralf PUFFER1, Richard WEISSNAR2, Klemens REICH2, Anita MACHL2

1RWTH Aachen University; 2Austrian Power Grid AG

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Marcelo MEZA, Johan SÁNCHEZ

ISA Interconexión Eléctrica

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Andrés LONDOÑO, Diego TAUTA, Juan SIERRA

EPM

**High Gradient Magnetic Fields Generated in Events on the 230 kV Electric Power Transmission Infrastructure: Human Exposure Analysis and Risk**

Fabián ROJAS1, Gerardo GERRA1, Luis DIAZ2, Carlos VARGAS2

1Enlaza Grupo Energía Bogotá; 2Conecta

**Development of an Application to Support Systems Integration and Operational Risk Assessment for Digital Substations and Smart Grids**

Carlos SANCHEZ1, Johan CASTRO1, Germán RUEDA1, Oscar TOBAR1, Rodolfo GARCIA2, Germán ZAPATA1

1Universidad Nacional; 2Enel Colombia
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<td>¹The University of Manchester UK; ²Monitra, Manchester UK</td>
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<td>¹Kahramaa, Qatar; ²Kahramaa, Qatar; ³Kahramaa, Qatar; ⁴GE Renewable Energy, QATAR; ⁵GE Renewable Energy, QATAR</td>
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PT. PLN (PERSERO), Indonesia

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Mayank RANA*, Pankaj Kumar JHA, M.S. HADA, Sandeep YADAV
POWER GRID CORPORATION OF INDIA LIMITED, India

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BHEL, India

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Anshul DUSHARMA*, R. P. S. RANA, M. Thirumala REDDY
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<td>Marcel STOECKLI¹, Mostafa REFAEY²</td>
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<td>¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Pfiffner Instrument Transformers, Switzerland</td>
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<td>Abdul Halim BAHARUDIN¹, Suthep SINGHARERG²</td>
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**Topics:** B3 PS2 - Return on Operational Experiences for Substation Management  
**Keywords:** Substation, Power Transformer, Distribution, Hazard

**Amesbury #5 Substation Emergency Power Transformer Relocation**  
Carli GAVIN  
National Grid, United States of America

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**Topics:** B3 PS2 - Return on Operational Experiences for Substation Management  
**Keywords:** Substation equipment fault, Lightning protection design, Resilience, Investigation for interpolar flashover, Multiple direct lightning strikes.

**Substation Design Improvement Considering Actual Accident Due to Direct Multiple Lightnings**  
Kelsuke MURAKITA  
TEPCO Power Grid, Inc.

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**B4 - DC SYSTEMS AND POWER ELECTRONICS**

**PS1 - DC Equipment and Systems**

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**B4 DC SYSTEMS AND POWER ELECTRONICS - Full Papers**

**Topics:** B4 PS1 - DC Equipment and Systems  
**Keywords:** HVDC transmission topologies, large offshore wind power connection, solutions, technology, renewable energy

**Technical-economic analysis of different HVDC transmission topologies for large offshore wind power connection**  
Tanh VU-CONG, Marco SCHUDEL, William BELE, Guillaume MEYER  
RTE, France

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**Topics:** B4 PS1 - DC Equipment and Systems  
**Keywords:** DC converter, DC voltage control, Modular multilevel converter, Multi-terminal DC grid

**EMT simulation of an MTDC system integrating Modular Multilevel DC/DC converter with DC voltage control**  
Ghazala SHAFIQUE1,2, Frédéric COLAS1,3, François GRUSON1,3, Xavier GUILLAUD1,3  
1L2EP, France; 2Arts et Metiers, France; 3Centrale Lille Institute, France

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**Topics:** B4 PS1 - DC Equipment and Systems  
**Keywords:** DC harmonics, EMT study, HVDC-LCC

**Study and mitigation of DC harmonics on Corsica’s SACOI HVDC-LCC station causing long unavailability, a case study.**  
Yannick VERNAY1, Jordann BRIONNE2, Julien MICHEL1  
1RTE, France; 2EDF, France

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**Topics:** B4 PS1 - DC Equipment and Systems  
**Keywords:** DC breakers, HVDC protection, interoperability, protection components sizing

**A contribution to HVDC protection interoperability through components sizing**  
Myriam RATAJCZYK1,2,3,4, Bertrand RAISON2,3,4, Alberto BERTINATO1, Pascal TORWELLE1  
1SuperGrid Institute, France; 2University Grenoble Alpes, France; 3CNRS, France; 4Grenoble INP, France; 5G2Elab, France

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**Advancement in HVDC Technology: Exploring Controllable Current Source Converters Utilizing Reverse Blocking IGBTs**  
Guangfu TANG1, Xiaoguang WEI1, Longlong CHEN1, Taosha JIANG1, Anyou DONG1  
1Beijing Huairou Laboratory,China; 2State Grid Smart Grid Research Institute Co., Ltd., China

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**Development and Engineering Application of Controllable-Line-Commutated Converter**

Zhiyuan HE¹, Chong GAO¹, Kunpeng ZHA², Jun YANG¹, Guangfu TANG², Dongshan HE¹

¹State Grid Smart Grid Research Institute, China; ²C-EPRI Electric Power Engineering Co., Ltd., China; ³Beijing Huairou Laboratory, China

**Key Techniques and Engineering Applications of ±500kV High Voltage and Large Capacity DC grid Based on Voltage Source Converter with 100% New Energy connected**

Jin ZHANG¹, Ming LI¹, Jie LIU¹, Zheng ZHAO², Tan LI², Qichen CHEN²

¹State Grid Corporation of China, China; ²State grid economic and technological research Institute Co., Ltd., China

**Key Technology of Baihetan-Jiangsu ±800kV Hybrid Cascaded UHVDC Transmission Project**

Dong LIU, Jing ZHOU, Jiabei ZHOU, Jie YANG

State Grid Smart Grid Research Institute Co., Ltd., Beijing, China

**Research and application of new technology and equipment for Baihetan-Jiangsu ±800 kV UHVDC project**

Kunpeng ZHA, Fan ZHANG, Yuefeng YANG, Fuyue WEN, Xiaolin ZHANG, Ting ZHAN

C-EPRI Electric Power Engineering Co., Ltd., China

**The world’s first series-connected multi-terminal LCC UHVDC transmission -- System studies for the Jinshang-Hubei ±800 kV project**

Ying XU¹, Ying PU¹, Zijian GAO¹, Ling WANG¹, Yajun LU¹, Weiran CAO², Andersson MATS², Ying YE², Xun WANG²

¹State Grid Economic and Technological Research Institute Co., Ltd. (SPERI), China; ²Hitachi Energy, China

**A Staged Approach for Upgrade of the Square Butte HVDC System**

Christian WINTER¹, Peter SchOMMER¹, Joanne HU², Bruno BISEWSKII²

¹Minnesota Power, United States of America; ²RBJ Engineering, Canada

**Innovative Design of a Reduced Scale Prototype for the New Multiterminal Italian HVDC Network with SiC-based HVDC Hybrid Circuit Breaker**

Pierluigi VACANTE

TERNA, Italy

**Software-In-the-Loop Real-Time Simulation of a HVDC Terminal**

Carl BARKER¹, Emmanuel AMANKWAH¹, Omar JASIM¹, Samek ELIMBAN², Stella ZHANG², Hui DING², Yuan CHEN², Paul FORSYTH²

¹GE Vernova UK; ²RTDS Technologies Inc., Canada
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Keywords: HVDC, harmonics performance, harmonic stability, frequency domain simulations

Application of Harmonic Loci-Based Control Design in Frequency and Time Domain for a Consistent Design of VSC HVDC Harmonic Active Solutions
Omar JASIM, Jose A R MONTEIRO, Nagasesha REDDY
GE Vernova UK

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Successful Test Method for primary Faults on a VSC-HVDC overhead Line
Martin PETTERSSON
Svenska krafträtet, Sweden

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Verification of Performance for VSC-HVDC with a DC primary Fault Test
Martin PETTERSSON
Svenska krafträtet, Sweden

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Topics: B4 PS1 - DC Equipment and Systems
Keywords: HVDC, offshore, planning, modularity, hubs

Modular offshore HVDC transmission planning principles
Cornelis PLET1, Maksym SEMENYUK1, Hans CLEIJNE1, Michel DUBBELBOER2
1DNV; 2TenneT

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Keywords: Bipole, Power Electronics Module, Offshore Interconnections, VSC-HVDC, Wind Farms, MultiTerminal Direct Current (MTDC)

±525 kV 2 GW Bipole VSC-HVDC Offshore Transmission (TenneT Projects) - Key Design Aspects
Ashish BANGAR1, Amit KUMAR2, Francisco CHACON2, Nadew Adisu BELDA1, Yogesh GUPTA2, Olivier RUITON2
1TenneT; 2GE Vernova

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LCC UHVDC System Improvements, with a novel Converter Transformer Configuration
Mats ANDERSSON
Hitachi Energy Sweden AB, Sweden

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Topics: B4 PS1 - DC Equipment and Systems
Keywords: HVDC, IT, System, Replacement, Cybersecurity, Extension, HMI

Two Approaches to HVDC IT System Replacement
Colin MADSEN1, Michael PARADIS1, Tong SHU1, Lee HARROP2, Lydia SMITH2
1ATCO Electric, Canada; 2Transpower, New Zealand

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B4 DC SYSTEMS AND POWER ELECTRONICS - Full Papers
Topics: B4 PS1 - DC Equipment and Systems
Keywords: Overload, Cable, Design, Maintenance

Labrador Island Link Overload Design Considerations
James NUGENT, Tyler THOMPSON
Newfoundland and Labrador Hydro, Canada
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<td><strong>Hydro-Québec's Chateauguay Back-to-Back HVDC Converter Replacement Project: Integration of New Operating Modes for System Resiliency Improvement and Water Management Effectiveness using VSC Technology</strong></td>
<td>Amr ABDELLAOUI, Vito DE LUCA, Marie-Jacinthe HEMSAS</td>
<td>Hydro-Québec, Canada</td>
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<tr>
<td><strong>Survey of the Reliability of HVDC Systems Throughout the World During 2021-2022</strong></td>
<td>P.V.I. TAIAROL</td>
<td>Advisory Group AG-04, Study Committee B4, Canada</td>
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<td><strong>Development and Application of HVDC Analysis System for Improving Operational Reliability</strong></td>
<td>Woojin CHO1, Insoo PARK1, Seonho LEE2, Olivier CLEMENCON3</td>
<td>1KAPES, Korea, Republic of (South Korea); 2KEPCO, Korea, Republic of (South Korea)</td>
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<td><strong>The experience of the Power Oscillation Damping Study based on the hybrid simulation method for the Bukdangjin 2nd project in South Korea</strong></td>
<td>Hyunjie YOO1, Kumar MANOJ2, Panyoung SUNG1, Hyunkeun KU3, Olivier CLEMENCON1</td>
<td>1KAPES, Korea, Republic of (South Korea); 2GE Grid Solution, UK; 3KEPCO, Korea, Republic of (South Korea)</td>
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<td><strong>A HVDC 800 kV link, enlarging regional interconnection, to increase the utilization of variable renewable generation</strong></td>
<td>Dourival CARVALHO, Rodrigo CABRAL, Tiago RIZZOTTO, Fabiano SCHMIDT, Thais TEIXEIRA</td>
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<td><strong>Crustal Conductance - an Index for the Estimate of the Minimum Electrode Size and Electrode - Converter Substation Distance</strong></td>
<td>Paulo Edmundo da Fonseca FREIRE</td>
<td>Brazilian NC of CIGRE, Brazil; PAIOL Engenharia</td>
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<td><strong>Analysis of Power Oscillation Damping Performance in Grid-forming VSC HVDC System</strong></td>
<td>Jae-hyuk KIM1, Hyung-seung KIM1, Hyun-jun KIM2, Jun-chol LEE1, Hong-ju JUNG1</td>
<td>1Hyosung, Korea, Republic of (South Korea); 2Hyosung Heavy Industries, Korea, Republic of (South Korea)</td>
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Generic EMT study circuit and TOV for the design of a DC link.
El-Mehdi KARMANI, Julien POUGET, Pierre RAULT, Marco SCHUDEL
RTE, France

The Greenlink Interconnector - A new 504 MW HVDC Interconnector
Jonathan RUDDY¹, Katrin RASCHKE², Ernest NKUSI², Vincent FOÓ³, Katherine HAROLD⁴
¹Greenlink; ²Siemens Energy; ³Sumitomo Electric Industries; ⁴WSP

Measures to secure long lifetime of an LCC based HVDC link with a potentially aged cable
Magne MEISINGSET¹, Jon Ivar JUVIK², Kees KOREMAN³, Thinus DU PLESSIS⁴
¹Statnett SF Norway; ²Statnett SF Norway; ³Tennet The Netherlands; ⁴Tennet The Netherlands

Refurbishment of the control and protection system devices and thyristor valve modules in the 300 MW Shin-Shinano No.2 Frequency Converter
Masanori TAKECHI¹, Masahito KANEKO¹, Shigenori KAKUNO¹, Taihei SATO², Takahiko KIKUI³
¹TEPCO Power Grid, Inc., Japan; ²Toshiba Energy Systems & Solutions Corporation, Japan; ³Hitachi,Ltd, Japan

Refurbishment and System Test of High Voltage Converter Unit 3 (HVCU3) at Vyborg Back-to-Back HVDC Link
Natalya LOZINOVA¹, Sergey KATANTEV², Maxim PESHKOY², Olga SUSLOVA¹, Evgeniy ZMAZNOV¹
¹JSC «NIIT», Russian Federation; ²PJSC ROSSETI, Russian Federation; ³JSC «R&D Center of FGC UES, Russian Federation

A classification framework for HVDC-based transmission grid architectures
Sarah ANHAUS¹, Patrick DÜLLMANN¹, Lars OSTERKAMP¹, Robert DIMITROVSKI², Paul MCNAMARA³, Juan-Carlos GONZALEZ⁴
¹RWTH Aachen University, Germany; ²TenneT TSO GmbH, Germany; ³EPRI Europe, Ireland; ⁴Super Grid Institute, France

Switching Voltage Capability of Air-Core Dry-Type VSC Converter Reactors
Klaus POINTNER, Wolfgang BIERBAUMER, Tanen MONNI
Trench Austria GmbH

Advanced Maintenance Recommendation for HVDC and FACTS Air-core Drytype Reactors
Bernhard FRÖHLICH, Alexander GAUN, Christian GRUBERBAUER
Coil Innovation GmbH
Overvoltages experienced by Metallic Return Cables in Bipolar HVDC Configuration
Max Goertz1, Simon Wening1, Daniel Barth1, Simon Beckler2
1Mosaic Grid Solutions GmbH, Germany; 2TransnetBW, Germany

Sunrise Wind: USA's first HVDC connected offshore wind farm
Lorenzo Zeni1, Gustavo F. Gontijo1, Peter MCGarley3, Lennart Schuetze2, Alejandro B. Salas2, Stefan Hansen3, Ahmed Soliman3
1Oesoed; 2Siemens Energy; 3Siemens Gamesa Renewable Energy

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1Aalborg University; 2Gadjah Mada University

HVDC Valve Hall Fire Incident: A Case Study at GCCIA Al Fadhili HVDC
Abdullah Alghamdi1, Jayakumar Muthusamy2, Ranjith Panigrahi3
1GCCIA, KSA; 2GCCIA, KSA; 3GCCIA, KSA

Dynamic Performance of Dual HVDC Terminals (+800 kV LCC and ±320 kV VSC) at the same busbar- Operational Experience
Narendra Kumar*, Puneet Tyagi, S. Bhattacharya, V. Diwakar, P. Ravi
POWEGRID, India

Challenges, Design Considerations & Field Studies for Relocation of Earth Electrode Station- User’s Perspective
Narendra Kumar*, Aditya B. Chandran1, Dr. Puneet Tyagi1, S. Bhattacharya1, Dr. Subir Sen1, Rohidas Maske2, Sandeep Kalantri2, Abhay Choudhary1
1POWEGRID, India; 2MSETCL, India

Operational Experience on the Black-Start Exercise of VSC Based HVDC Systems in Southern Regional Grid of India
Arthi Sahaya Rones V*, Nikhitha C J, T Muthu Kumar, T Srivivas, S P Kumar
Grid-India, India

Addressing Operational Contingencies Faced in Parallel Operation of ±800 kV 6000 MW Champa Kurukshetra HVDC Link.
Anoop Kumar*, Keshav Gupta, Gopesh Kumar Jhajharia, Vishnu Parkash Srivastava
POWEGRID, India
**Evolving of protection strategies for DMR Faults in the ±800 kV 6000 MW Champa Kurukshetra HVDC Link.**

Anoop KUMAR*, Gopesh Kumar JHAJHARIA, Vishnu Parkash SRIVASTAVA

POWERGRID, India

**A Novel Methodology to Derisk HVDC and Offshore Wind Connections to A Network**

Xiao-Ping ZHANG1, Shuailong DAI1, Chengyi WU1, David LI1, Dechao KONG2, Xiaoyao ZHOU2

1University of Birmingham UK; 2NG ESO

**Test procedures for ± 500 kV HVDC circuit breakers: how to assess their performances based on current world laboratory facilities**

Sino PATTI1, Massimo MARZINOTTO1, Giuseppe PELLICCIONE1, Roy NIJMAN2, Shankar SUBRAMANY2, Roberta ALUNNI1

1Terna S.p.A; 2KEMA Labs; 3CESI S.p.A

**Optimal Control Selection for Grid-Forming MMC-Based Assets: An analysis of interplay between GFM and internal MMC controls**

Eros AVDIAJ, Jef BEERTEN

KU Leuven ESAT/ELECTA & EnergyVille

**Integrated Design Scheme of VSC-HVDC System for 10GW Large-Scale New Energy Ultra-long-distance Transmission**

Qingming XIN, Junjie FENG, Zhiyong YUAN, Xiaobin ZHAO, Chuang FU, Ting HOU, Biyue HUANG, Yuebin ZHOU, Changyue ZOU

State Key Laboratory of HVDC, Electric Power Research Institute of China Southern Power Grid, Guangzhou 510663, China

**220kV Direct-connected Static Synchronous Series Compensation and the First Demonstration Application in China**

Yuhong WANG, Kunpeng ZHA, Xiong ZHAN, Gang ZHAO, Yuefeng YANG, Lanfang LI

C-EPRI Electric Power Engineering Co., Ltd., China

**Design of Hybrid Active AC filter Scheme in MinYue back-to-back DC Project**

Yiming JI1, Yiran CHANG2, Yiming YANG1, Xiujuan ZHANG1, Fangjie WU1, Ling WANG1

1State Grid Economic & Technological Research Institute, China; 2RONGXIN HUIKO Electric Co., LTD., China; 3Sieyuan Qingneng Electric & Electronics Co. Ltd. China
Key Technologies and Engineering Application of Distributed Power Flow Controller

Yizhe LIN, Lei PAN, Qiang ZOU, Yunlong DONG
NR Electric CO., LTD, China

Stability enhancement of weak Grids with high penetration of Renewables with grid-Forming STATCOM/Enhanced-STATCOM

Rasool HEYDARI
Hitachi Energy Sweden AB, Sweden

Health Monitoring Approaches for high Voltage Capacitors in Power Converters

Riddhi GHOSH
Hitachi Energy Sweden AB, Sweden

Application of Large STATCOMs for Dynamic Reactive Support in California 500kV Series Compensated Transmission System

Joanne HU1, Eric STAUFFER2, Stefan SCHILLING3, Bruno BISEWSKI1, John RANDOLPH2, Felix NABEIN3
1RBJ Engineering, Canada; 2LS Power, USA; 3Siemens Energy, Germany

Transformer-coupled Static Synchronous Series Compensators for transmission and distribution operators, based on industrial-class converters

Markel ZUBIAGA1, Javier CHIVITE2, Pedro IZURZA1, David SANTOS2, Javier CAÑAS1
1Ingeteam Research Institute, Spain; 2Ingeteam P. Technology, Spain

Experimental validation of the General Power Theory using Power-Hardware in the Loop - opportunities for new converter controls

Trevor GAUNT
University of Cape Town

The Analysis of the SSR between TCSC and Synchronous Generator using RTDS and TCSC Replica

Hyunkeun KU, Seungchan OH, Yonghan KROWN, Injoo JUNG, Moonsung BAE, Gumin KROWN, Hyukil KROWN, Jeonghoon SHIN
Korea Electric Power Corporation, Korea, Republic of (South Korea)

Hunting Issues in the Brazilian Interconnected Power System – A Case Study of Multiple SVCs

Antonio Ricardo TENÓRIO1, Saulo SILVA FILHO4, Rodrigo PRAZEDES3, Felipe SOBRINHO2
1Brazilian NC of CIGRE, Brazil; ONS; 2ARGO; 3Hitachi Energy; 4Jordão Energia
The Vectorized Approach: An Efficient Method to Model VSC Converters and its Verification Against Tests
Joan HERNANDEZ, P. SAMUELSSON, Y. JIANG HÄFNER
Hitachi Energy Sweden AB

Improved dynamic Voltage Control based on Network Sensitivity Characteristics
Francisco Javier CIFUENTES GARCIA, Özgür Can SAKINCI, Jef BEERTEN
EnergyVille/KU Leuven, Belgium

Verification of PEDI in Japan and suppression by STATCOM
Naoki TANI¹, Keigo NISHIDA², Hiroaki OSHIKAWA², Kohei ONOSATO³, Toshiyuki FUJI¹
¹Mitsubishi Electric Corporation, Japan; ²Kyushu Electric Power Transmission and Distribution Co., Inc., Japan; ³Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan

Subsynchronous Resonance Analysis for an M-SSSC FACTS Installation in the Atlantico Region of the Colombian Transmission System
Juan BOTERO¹, Carlos BORDA¹, Mohammad HAMMAD²
¹Smart Wires Inc; ²Siemens Energy

Operation of Static Series Synchronous Compensators integrated into the Colombian Power System: Challenges, Experiences and Lessons Learned
Jaime PINZÓN, Camilo MORENO
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Reflection on applicable standards and learnings from actual failures of power inverters
Muhammad ALSUHAILY¹, Robert HEUCKELBACH², Ashutosh SHARMA², Sukant BHATTACHARYA²
¹DNV, UAE; ²DNV, The Netherlands; ³DNV, UAE; ⁴DNV, UAE

A novel DC transmission technology based on the Self-adaption statcom and line commutation converter
Weimin MA, Xiaolin SHEN, Chenguang LIANG
State Grid Economic and Technological Research Institute Co., LTD . China
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<td><strong>Application of Multi-ports Energy Router to Coordinated Control of Renewable Energy, Network, Load and Storage at County-level Power Grid</strong></td>
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<td>Chong ZHANG¹, Zhiyuan HE¹, Xiaotong JI², Huafeng WANG³, Xueguang WU¹, Junda QIN¹</td>
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<td>¹State Grid Smart Grid Research Institute Co., Ltd., China; ²State Grid Hubei Electric Power Co., Ltd., China</td>
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<td>Yuntao XIAO, Guanghui LI, Weisheng WANG, Guoqing HE, Ni ZHEN</td>
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<td><strong>Grid-Forming Control for VSC-HVDC System with Large-scale New Energy Integration</strong></td>
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<td><strong>Linear PV power plant based on MVDC collection network</strong></td>
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<td>Piotr DWORAKOWSKI¹, Silvain MARACHE¹, Eric LAMARD², Caroline RAMONDOU²</td>
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<td><strong>Online On-state voltage Condition Monitoring of IGBT power modules for MMC-HVDC applications</strong></td>
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<td>Nadine CHAPALAIN¹, Huai WANG²</td>
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<td>¹Mitsubishi Electric R&amp;D Centre Europe, France; ²Aalborg University, Denmark</td>
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<td><strong>Modeling, Analysis, and Control of an Islanded Grid-Connected RES-Hydrogen DC Microgrid with Floating Solar Integration</strong></td>
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<td>Libin VARGHESE, Peng ZHANG</td>
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<td>Gianluigi GEMELLI</td>
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<td><strong>A new STATCOM topology equipped with short-time energy storage and Grid Forming control for HV network voltage and frequency regulation</strong></td>
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<td>Gianluca POSTIGLIONE</td>
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**Transient phenomena following pole-to-ground fault on MMC-HVDC system equipped with Half-bridge submodules and Hybrid DC breakers**  
Samuel DE MARIA  
TERNA, Italy

**ID: 10408**
B4 DC SYSTEMS AND POWER ELECTRONICS - Full Papers  
Topics: B4 PS3 - New Technologies and Concepts of DC and FACTS enabling Energy Transition  
Keywords: HVDC, Grid-forming, Synchronous-Grid-forming, Demand, Demand-ramp, Fault-recovery, Inertia  

**Dynamic demand control applied to synchronous grid forming controlled HVDC**  
Carl BARKER¹, Si DANG¹, Omar JASIM¹, Syed Aaqib HASSAN², Girish G³, Kerry EVANS³, Taoufik QORIA⁴  
¹GE Vernova UK; ²GE Vernova India; ³GE Vernova USA; ⁴GE Vernova Germany

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Topics: B4 PS3 - New Technologies and Concepts of DC and FACTS enabling Energy Transition  

**On the Role of Energy Storage in the Future HVDC Systems**  
Frans DIJKHUIZEN  
Hitachi Energy Sweden AB, Sweden

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Topics: B4 PS3 - New Technologies and Concepts of DC and FACTS enabling Energy Transition  
Keywords: Multi infed interaction factor (MIIF), Modular multilevel converter (MMC), HVDC, Point of Interaction (POI), Faults, Load rejection  

**Analysis of Converter Interactions in HVDC systems**  
Pragati KIDAMBI MURALI, Jiayang WU, Theo BOSMA, Yontao YANG, Cornelis PLET  
DNV

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Topics: B4 PS3 - New Technologies and Concepts of DC and FACTS enabling Energy Transition  
Keywords: DC Transmission, EMT, Grid forming, HVDC, STATCOM  

**Application of Synchronous Grid Forming Back-to-Back HVDC System for System Frequency Support**  
Arash FAZEL DARBANDI¹, Phaedra TAIAROL¹, Sharmen ANDREW², Ani CHOPRA³  
¹Stantec, Canada; ²Berkshire Hathaway Energy Canada, Canada

**ID: 10623**
B4 DC SYSTEMS AND POWER ELECTRONICS - Full Papers  
Topics: B4 PS3 - New Technologies and Concepts of DC and FACTS enabling Energy Transition  

**New VSC-HVDC interconnection between the Iberian Peninsula and Balearic Archipelago to enable energy transition**  
Javier RENEDO, Silvia SANZ VERDUGO, Antonio CORDÓN, Belén SEGURA, David CASTAÑEDA, Rosalia RIVAS, Patricia LABRA  
Red Eléctrica, Spain

**ID: 10624**
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**Development of an EMT model of the Balearic power system**  
Javier RENEDO¹, Yousef PIPELZADEH², Dharshana MUTHUMUNI³, Farid MOSALLAT⁴, Silvia SANZ VERDUGO¹, Antonio CORDÓN¹, Edgar NUÑO⁵, Macarena MARTIN⁶  
¹Red Eléctrica, Spain; ²MHI, UK; ³MHI, Canada; ⁴Canada

**ID: 10626**
B4 DC SYSTEMS AND POWER ELECTRONICS - Full Papers  
Topics: B4 PS3 - New Technologies and Concepts of DC and FACTS enabling Energy Transition  

**Performance of Generic grid forming RMS models under standardized test contingencies**  
Benjamin PAZ¹, Hazem KARBOUJ², Shrivraman MUDALIYAR², Deepak RAMASUBRAMANIAN³, Xiaoyao ZHOU²  
¹EPRI Europe, Spain; ²National Grid ESO, UK; ³EPRI, USA
Battery storage with power oscillation damper for improved stability performance
Manfred MANCHEN
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DC Circuit Breaker feasibility study - protection system design
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Grid-Forming Variable-Speed Full Converter Pumped-Storage Hydropower
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Bi-mode Insulated Gate Transistor BIGT - An Outstanding Key Component in Present and Future HVDC Systems
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Grid Connection of Offshore Wind with Grid Forming Turbines
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Expandability of offshore HVDC grids during (in) development planning considering protection system design
Merijn VAN DEYCK, Geraint CHAFFEY, Mudar ABEDRABBO, Hakan ERGUN, Dirk VAN HERTEM, Ervin SPAHIC, Dennis DE DECKER
1KU Leuven and EnergyVille, Belgium; 2WindGrid, Elia Group, Belgium

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1KU Leuven and EnergyVille, Belgium; 2RWTH Aachen, Germany; 3TUBS, Germany; 4Siemens Energy, Germany; 5UPC, Spain; 6KTH, Sweden

DC System power quality and stability assessment and management: method, simulation, and on-site validation
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Dynamic Analysis of a Synchronverter with Virtual Inertia for Wind Power System Integration

Kah Yung YAP, Osazee Edo IDEHEN, Jakob Boss SKÅRHØJ
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Energy Dissipation Strategies for Offshore MT-HVDC systems

Alban DUVIVIER1, Nicolaos CUTULULIS1, Oscar S.-ROMANO1, Peter Jan RANDWIJK2, Li YANG3
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DC Voltage Control Strategy for NEOM Multi-terminal HVDC Grid

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An 100% renewable power system through innovative HVDC technology-based power system architecture

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Stability Analysis and Mitigation of Power Oscillations Between Parallel MMC-HVDC Connections Operating in Grid-Forming Mode in Offshore Energy Hubs

Benjamin VILMANN1, Daniel MÜLLER1, Gustavo Figueiredo GONTIJO2, Hjörtur JOHANNSSON1
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Phased Approach to MTDC: Proposed integration of DC Circuit Breakers in a DC Switching Station facilitating a partially selective protection scheme

David DEVOY, Ian COWAN, Perry HOFBAUER
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Keywords: Digital Substation, Intelligent Electronic Device (IED), Merging Unit (MU), Process Bus, Protection Automation and Control Systems (PACS)

Digital substation with process bus: grid operator and PACS manufacturer feedback 2 years after the commissioning
Gérard CHAROT, Valentin BOUVIGNIES, Julien TISSERAND, Samir EL HADI, Apolline MAZAS, Sylvain AUPETIT
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Object Modeling of Process-near Interface Intelligent Electronic Devices in Digital Substations

Alexander APOSTOLOV
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Interoperability of protection devices among a multi-vendor IEC 61850 process bus system

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Unified Grid Control Platform Requirements of Process Bus

Herb FALK1, Paul MYRDA1, Glenn WILSON2, Sean MCGUINNESS3, Eric UDREN4
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Quiet Revolution: How Low-Power Instrument Transformers and Digital Secondary Systems are Changing What is Possible

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Assessment of Time-Critical IEC 61850 Process Bus Communications in a Virtualized Protection and Control System

Ana Cristina ALEIXO, Fernando GOMES, Carlos ARANTES, José VENTURA, João PERES, Rui JORGE
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DSAS Rollout Experience - Picking the Ripe Fruits

João PERES, Sara COSTA, Rui JORGE, Diogo CORREIA
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Distance Protection Performance Evaluation with Process Bus by using Modular Merging Units

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Impact on Busbar Protection by mixed analogue Input Chains in digital Substations

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*Experiences with process bus technology for substation retrofit*

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Keywords: IEC 61850-9-2 process bus, transformer protection

*Practical experiences with process bus based transformer protection system*

Marcel STOECKLI¹, Stefan MEIER², Ruben MARTINI¹, Markus HELWIG²
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Keywords: digital substation (DS), merging unit (MU), PTP, time synchronization system, protection, automation and control (PAC), IED 61850-9-2, digital exchange

*SV-stream Processing in the Event of Synchronization Loss by Publishers*

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Keywords: transmission line differential protection, IEC 61850-9-2(SV), process bus, cybersecurity, relay protection prototype

*Pilot Operation of Transmission Lines Differential Protection with Information Exchange According to IEC-61850-9-2 (SV)*

Aleksandr KULIKOV¹, Anton LOSKUTOV¹, Vladimir ZININ², Anton PETROV¹
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Keywords: protection and automation, digital substation, process bus, virtual IEDs, migration of functions, pilot operation

*Development and Pilot Operation of the Intelligent PAC System Using the Concept of Virtual IEDs and Migration of Functions*

Andrey LEBEDEV¹, Alexander VOLOSHIN¹, Andrey ZHUKOV², Vitaly AKULICHEV²
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Developments and Practical Experiences of Merging Unit

Dmitry ULYANOV¹, Andrey MARTYNOV¹, Alexey MOKEEV², Sergei PISKUNOV²
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Experience and Challenges in the Practical Implementation of Four Digital Substations in Brazil

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Digital Substation: Lessons Learned by CPFL in Process Bus Application

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LPIIT operational experiences and challenges in a Norwegian digital substation

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Advantages and Challenges in Implementing the IEC 61869-9 Standard versus IEC 61850-9-2-LE in the Digitization of the Right Bank Substation

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Using process bus over substation boundaries with multi-vendor line differential protection

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Experiences from a substation pilot project implementing process bus based partly centralized protection and control

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**The Full Digital Substation Success in Vietnam**

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**Assessment of Distributed and Centralized Protection: Comparison of Response Times for Protective Dynamic System on Process Bus**

Johan CASTRO\(^1\), Germán RUEDA\(^1\), Rodolfo GARCÍA\(^2\), César HERNÁNDEZ\(^1\), Germán ZAPATA\(^1\), Oscar TOBAR\(^1\)

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**Merging Unit Performance Evaluation and Issues for Multi-Vendor Configuration in Process Bus**

Hiroki DOI\(^1\), Noriyuki UEDA\(^1\), Akihiro TANAKA\(^1\), Kenji KONDOU\(^2\), Makoto MIZUNO\(^2\), Yusaku SANO\(^2\)

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**Case Study: IEC 61850 Process Bus-Based Protection System Applications For One and Half Breaker Bus System in NEPCO 400 Kv stations**

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National Electric Power Company, Jordan, Hashemite Kingdom of
Impact of IEC 61869-9 Based Sampled Values on Network Optimization and Protection System Performance in a Process Bus Based Digital Substation

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Commissioning & Operational Experiences of Brownfield & Greenfield Process Bus Substations in POWERGRID

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A comprehensive approach towards implementing the Process Bus based Substation Automation system in Substations and its benefits.

Vikram GANDOTRA*, Laurent TOOGNAZZI, Hamza EHTISHAM, Nimish RASTOGI
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Reliable Time Synchronization for IEC 61850 Substations by Distributed Time Sources and Visibility

Raymond SHIEH, King WU, Sever SUDAKOV
Moxa Tai\text{\textw}wan

Experience and Challenge in Deploying the IEC 61850 Driven Digital Substation within Indonesia Utility Context

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Field testing, Experiences and Results with Line Differential and Teleprotection Applications in TDM/MPLS-TP Hybrid Networks

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Coordinating Zone Settings of Distance Protection with Reactive Power Capabilities and Voltage Support of Inverter-based Resources

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Keywords: Distance relay, harmonics, converter-connected generation, relay testing
Performance of Distance Relays in the Finnish Power System under High Penetration of Converter-Connected Generation
Valtteri HYTTI, Pauli PARTINEN
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Keywords: Distance Protection, Total Harmonic Distortion, Power System, Secondary Injection
Experiences, Secondary Injection testing and Grid Studies on Distance Protection and Current and Voltage Harmonics during Power System Faults
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Testing approach for Rte’s R#SPACE Protection Automation and Control System
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Keywords: Low Power Instrument Transformer (LPIT), Secondary Injection Test Kit, Low Power Relay Test Set, Low Power Voltage Transformer, Merging Units
LPITs in High Voltage Switchgear and Field-testing of Relay Protection with LPIT Inputs
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Keywords: IEC 61850, Acceptance, Commissioning and Maintenance Testing, Efficiency
Improving the Efficiency of Acceptance, Commissioning, and Maintenance Testing of IEC 61850 Based Digital Substations
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Keywords: Digital Substation, IEC 61850, UCAIug, Interoperability Tests, System Configuration Language
Experience in the UCA International Users Group Interoperability Tests
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Use of Detailed Real-Time System Models to Evaluate Relay Performance Impacted by High Penetration of Inverter-Based Resources

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Life-cycle Testing of Synchrophasor Systems

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Protection and Control of Active Distribution Systems

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Evolution of Testing Practices: A Utility’s Experience

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Testing of Centralized Protection, Control and Advanced Automation for MV networks with DER

Clara GOUEIA1, Everton ALVES1, André MELIM1, Jorge PEREIRA1, António CARRAPATOSO1, Nuno FONSECA1, José ANDRADE1, Tiago HEKKERT1, Ana Cristina ALEIXO2, Carlos ARANTES2

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Implementation of the line differential protection in the 30 kV distribution network of i-DE

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Development and Implementation of a WAMPAC Algorithm for Detecting Real-Time Voltage Instability Phenomena in Electric Power Systems

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Challenges and perspectives for a new era of protection, automation and control systems through IEC 61850

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IEC61850 Engineering of a Digital Substation: Common User Vision on Top-down Engineering

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PMU-based fault distance calculation in long radial feeders using an enhanced reactance-based approach

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The Experience of Commissioning and Initial Maintenance of Relay Protection on Operational Digital Substations with the IEC 61850 Process Bus

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A New Technological Approach for Commissioning and Operation of Relay Protection and Automation Systems

Alexey Anoshin, Aleksandr Golovin, Natalya Mararakina

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Experience of the Field Testing of Power Units Control Systems

Andrei Gerasimov, Ruslan Izmailov, Evgeniy Satsuk, Andrei Smirnov, Dmitriy Kabanov, Oleg Gurikov

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Experimental Verification of Fault Location Technology in Power Distribution Networks with Complex Topology

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Development and Commissioning of PACS for Operating Modes of the Power System Based on PMU Data
Andrey ZHUKOV¹, Evgeniy SATSUK¹, Dmitrii DUBININ², Stepan DMITRIEV³, Jury IVANOV³, Alexander HOHRIN³
¹JSC SO UPS, Russian Federation; ²Ural Federal University, Russian Federation; ³Prosoft systems, Russian Federation

Methods for Configuring, Testing and Inspecting Automatic Excitation Regulators for Synchronous Generators during Commissioning
Andrey ZHUKOV¹, Evgeniy SATSUK¹, Tatiana KLIMOVA², Andrei GERASIMOV¹
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Commissioning Perspectives for the New Era of Transmission Line Protection Schemes: Historical Evolution and Future Expectations
Felipe LOPES¹, Moisés DAVI², Giovanni FABRIS³, Mário OLESKOVICZ³, Raphael REIS¹
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Guilherme LISBOA, Guilherme NORMANTON
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Alejandro DUQUE¹, Dilan CARO¹, David URBÆZ², German GUTIERREZ², Jhon CALDERON³, Carlos BORDA¹
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Enhancing Protection Schemes for Inverter-Based Renewable Generation in Transmission Networks
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Nikolay SHUBIN¹, Fedor NEPSHA¹, Vladimir TARASOV², Evgeniy SATSUK³
¹RTSoft Smart Grid, LLC, Russian Federation; ²INTER RAO Engineering, LLC, Russian Federation; ³JSC SO UPS, Russian Federation

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Fernando POSTIGO¹, Andrés RAMIRO¹, Belén DÍAZ-GUERRA¹, Santiago PEÑATE²
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Ajla MERZIC¹, Nedzad HASANSPAHIC², Muamer BAHTO², Mustafa MUSIC²
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Aurora OPSTAD¹, Kristian SEVDARI², Heidi S. NYGÅRD², Bjørn Harald BAKKEN¹, Gerard DOORMAN¹
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Battery Energy Storage System Techno-Economic Performance to Meet the Grid Flexibility: Case Study of Jordan’s Power Sector
Murad ALOMARI, Mustafa Walid ALZAHLAN
National Electric Power Company, Jordan, Hashemite Kingdom of

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¹50Hertz Transmission GmbH, Germany; ²Hamburger Energiewerke GmbH, Germany
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1ENOWA, KSA; 2ENOWA, KSA; 3Hitachi Energy, Switzerland; 4Hitachi Energy, Switzerland

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Department of Energy (AAU Energy), Aalborg University

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1EDF, France; 2Mines Paris PSL, France
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**PS3 - RESILIENCE AS PIVOTAL CRITERION FOR SYSTEM DEVELOPMENT**

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1Brazilian NC of CIGRE, Brazil; 2Eng Smart Lead; 3Consultant; 4Eletronorte

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1The National HVDC Centre UK; 2EPRI International Ireland; 3Engie Impact Belgium

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1Comisión Nacional de Energía, Chile; 2STM, Chile; 3Coordenador Eléctrico Nacional, Chile

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1Polaris System Optimization, United States of America; 2Newton Energy Group, United States of America; 3Tabors Caramanis Rudkevich, United States of America

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1Kansai Transmission & Distribution, Inc., Japan; 2Meteorological Engineering Center, Inc., Japan
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1Brazilian NC of CIGRE, Brazil; PSQ; 2Brazilian National Engineering Academy

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1 Branch of SO UPS, JSC, Karelian Regional Dispatch Office / Petrozavodsk State University; 2 Branch of SO UPS, JSC, United Dispatch Office of the North-West Energy System; 3 Peter the Great St Petersburg Polytechnic University

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1 Hangzhou Dianzi University, China; 2 Sichuan University, China; 3 North China Electric Power University, China

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1 North American Electric Reliability Corporation (NERC), United States of America; 2 Elevate Energy Consulting, United States of America

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1 Electric Power Research Institute (EPRI), United States of America; 2 Terna, Italy; 3 Oak Ridge National Laboratory, United States of America

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1 TenneT TSO; 2 Artelys; 3 TU Delft

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1Montenegrin Transmission System; 2Faculty of Electrical Engineering

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1ELECTROSUISSE, Switzerland - CIGRE Nc Secretariat; 2Swissgrid Ltd, Switzerland

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1Chubu Electric Power Co., Inc., Japan; 2Chubu Electric Power Grid Co., Inc., Japan
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Impact of the balancing strategy in future meshed HVDC offshore systems
Felix RUDOLPH¹, Simon KRAHL², Albert MOSER³
¹FGH GmbH, Germany; ²FGH e.V., Germany; ³IAEW, RWTH Aachen, Germany
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<td>Lie XU¹, Ramon GIMENEZ², Md HABIBURAHMAN³, Nagaraju POGAKU³, Peng LI³, Nand SINGH³, Grain ADAM³</td>
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<td>¹University of Strathclyde,UK; ²University Polytechnic of Valencia,SPAIN; ³ENOWA, NEOM, KSA</td>
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Liang HUANG, Daniela PAGNANI, Frede BLAABJERG

1 Aalborg University; 2 Ørsted A/S

**AEP’s Operation Strategy for High Share of RES: Linear State Estimator and Oscillation Monitoring**

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1 Electric Power Group (EPG); 2 American Electric Power Service Corporation (AEP)

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1 Antea Group; 2 TenneT

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1KEPCO Research Institute, South Korea; 2KEPCO, South Korea

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1Nikola Tesla Institute of Electrical Engineering, Republic of Serbia; 2Elektromreza Srbije JSC, Republic of Serbia; 3Elektroistok – Projektni biro, Republic of Serbia

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1Statnett SF Norway; 2NINA Norway; 3NTNU Norway
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1Elektroinštitut Milan Vidmar (EIMV); 2Elektroinštitut Milan Vidmar (EIMV); 3Elektroinštitut Milan Vidmar (EIMV); 4Elektroinštitut Milan Vidmar (EIMV); 5Elektroinštitut Milan Vidmar (EIMV); 6Elektroinštitut Milan Vidmar (EIMV); 7Elektroinštitut Milan Vidmar (EIMV); 8Elektroinštitut Milan Vidmar (EIMV);

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Ural Federal University, Russian Federation

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1Hitachi Energy Germany AG, Germany; 2Karlsruhe Institute of Technology, Germany

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1Enlaza Grupo Energía Bogotá; 2Conecta

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1 Egyptian Electricity Holding Company EEHC; 2 Senior Counsellor for Energy & Environment

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China Electric Power Research Institute, China

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1 ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2 Hitachi Energy, Switzerland; 3 ETH Zurich, Switzerland
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1Siemens Energy Austria; 2Siemens Energy Germany; 3Siemens Energy Canada

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1Kuwait Authority for Partnership Projects, KUWAIT; 2Kuwait Authority for Partnership Projects, KUWAIT

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¹Elektromreža Srbije JSC, Serbia; ²Institute Mihajlo Pupin, University of Belgrade, Serbia; ³Dirigent acoustica LLC, Serbia

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Keywords: Carbon footprint; water footprint; life cycle assessment; sustainability

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Brazilian NC of CIGRE, Brazil; Eletrobras CEPEL

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Nagoya University, Japan

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¹Toshiba Energy Systems & Solutions Corporation, Japan; ²Toshiba Infrastructure Systems & Solutions Corporation, Japan
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Elia Group, Belgium

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¹Thyssenkrupp Electrical Steel, Germany; ²Siemens Energy, Germany; ³Siemens Energy, Austria

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POWERGRID, India

Changes in Nordic Power System Dynamics due to massive Introduction of Wind and solar Power and identified needs for Nordic co-operation
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¹Fingrid Oyj; ²Svenska Kraftnät; ³Energinet; ⁴Statnett

An open-source tool for the validation of power park modules generic
Carmen CARDOZO¹, J. L. MARIN², M. DE MIGUEL², G. OMS², Adrien GUIRONNET¹
¹RTE R&D, France; ²Grupo AIA, Spain

Parallel simulation of a wide-area EMT model with high penetration of power electronic converters using co-simulation: a real case study
Boris BRUNED, Mehdi OUAFI, Ambroise PETIT, Valentijn COSTAN, Yannick VERNAY
RTE, France
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Keywords: Power systems, Inverted-Bases Resources (IBR), Battery energy storage systems (BESS°, Renewable energy sources (RES)

Study of new types of dynamic interactions in power systems with mixed classical and renewable generation
Pamela ZOGHBY1,2,3, Bogdan MARINESCU2,3, Antoine ROSSE1, Grégoire PRIME1
1 EDF R&D, France; 2 École Centrale Nantes, France; 3 LS2N, France

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Keywords: Available Short Circuit MVA, Grid Forming, Positive Sequence Models, Synchronous Condensers

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Deepak RAMASUBRAMANIAN
Electric Power Research Institute (EPRI), United States of America

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Keywords: Frequency Stability, Inverter-based Resources, Power/Frequency Control, Voltage Control

Unlocking Capability in Transmission Connected Inverters for Improved Reliability of Transmission Power Networks
Deepak RAMASUBRAMANIAN1, Sushrut THAKAR1, Julia MATEvosyan2
1 Electric Power Research Institute (EPRI), United States of America; 2 Energy Systems Integration Group (ESIG), United States of America

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Keywords: Offshore Wind Farm, Inter-array Cable, Collector System, Collector Network Equivalent, Electromagnetic Transient

Collector System Equivalencing with Frequency-Dependent Representation for Electromagnetic Transient Models
Swetha SRINIVASAN, Monica PADALA, David ROOP, Kaitlyn BABIARZ, Adam SPARACINO
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**Keywords:** Battery Energy Storage System, Grid Forming, Inverter-Based Resource, Modelling  
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\(^1\)North American Electric Reliability Corporation (NERC), United States of America; \(^2\)Electranix, Canada; \(^3\)Electric Power Research Institute (EPRI), United States of America; \(^4\)Energy Systems Integration Group (ESIG), United States of America; \(^5\)National Renewable Energy Laboratory (NREL), United States of America; \(^6\)Elevate Energy Consulting, United States of America  

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\(^1\)University of Tennessee, United States of America; \(^2\)Dominion Energy, United States of America; \(^3\)Oak Ridge National Laboratory, United States of America  

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\(^1\)Consulting Services at GE Vernova, United States of America; \(^2\)Hickory Ledge Consulting LLC, United States of America; \(^3\)Electric Reliability Council of Texas (ERCOT), United States of America  

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Joakim BJÖRK  
Svenska kraftnät, Sweden  

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Lena MAX  
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\(^1\)BEAMS, Université libre de Bruxelles, Belgium; \(^2\)Dept. of Electronic and Electrical Engineering, University of Strathclyde, United Kingdom  

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<td><strong>Automatic Detection of Subsynchronous Oscillations</strong></td>
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<td>Diptargha CHAKRAVORTY¹, Alexandru Christian NEAGU², Jochen I CREMER²</td>
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<td>Diptargha CHAKRAVORTY¹, Jaime TRIVINO¹, Sami ABDELRAHMAN²</td>
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<td>Shahil SHAH¹, Jingwei LU², Nilesh MODI¹</td>
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<td>¹National Renewable Energy Laboratory, USA; ²Australian Energy Market Operator, Australia</td>
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Large scale grid forming BESS replaces synchronous generation enabling high renewable penetration & low system load in Australia’s major northern grid

Brendan TRUONG1, Stanislav CHEREVATSKY2, Stephen SPROUL2, Vimeshan PILLAY1, Heath LANG3
1Power and Water, Australia; 2Hitachi Energy, Australia; 3Owners Engineer - Territory Generation, Australia

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Automated Testing of Smart Grid Controls using a System Level Approach

Filip PRÖSTL ANDRÉN1, Catalin GAVRILUTA1, Denis VETTORETTI1, Marco MITTELSDORF2
1AIT Austrian Institute of Technology; 2Fraunhofer ISE

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On the use of the congestion forecast processes for early warning of increased risk of major disturbances

Benoît BLETTERIE1, Martin LENZ2, Mike Alexander LAGLER1, Herwig RENNER2
1Austrian Power Grid; 2Graz University of Technology

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Maximizing the Generator Hosting Capacity Using Grid-Forming BESS

Cheng TAN, Jiacheng LI, Athmi JAYAWARDENA, Nalin PAHALAWATTA
Hatch, Australia

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Investigation of Grid Forming System Strength Solutions in Victoria

Logan PETERS, Yiju MA
Australian Energy Market Operator, Australia

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Keywords: Phasor Measurement Units, Real Time Monitoring, Voltage Stability Assessment, Power System Security, Oscillation Damping

PMU Applications for Voltage Stability monitoring and Oscillation analysis

Costas VOURNAS1, Panos MANDOULIDIS1, Orestis DARMIS1, Spiros CHOUNTASIS2, Stavros TSAKIRIS2, George KORRES1
1ECE NTUA, Greece; 2IPTO, Greece

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Frequency Stability and Fast Frequency Response in Hybrid AC-DC Transmission Grids: A Comparative Study of EMT and RMS Modelling Approaches

Sotan CHOUDHURY, Aaron HEBING, Anna PFENDLER, Niklas David STURM, Xiong XIAO, Jutta HANSON
Technical University of Darmstadt, Department of Electrical Engineering and Information Technology, Institute of Electrical Power Supply with Integration of Renewable Energies

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Minimum Modelling Detail on P2P VSC HVDC Connection Considering Grid Strength

Roni IRNAWAN1, Rian Fatah MOCHAMAD1, Filipe Faria DASILVA2, Qi ZHANG2
1Universitas Gajah Mada, Indonesia; 2Aalborg University, Denmark
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KAHRAMAA's experience in installing Wide Area Monitoring System (WAMS) in the Transmission Network

Noora ALDERHIM
Qatar General Electricity & Water Corporation "KAHRAMAA", Qatar

Enabling System-Level EMT Studies of Danish Power Systems

Yicheng LIAO¹, Liang LU¹, Jun Bum KWON¹, Nan QIN¹, Dharshana MUTHUMUNI², Yousef PIPELZADEH², Karl DIRKS²
¹Energinet; ²Power Systems Technology Centre

SSSC Model Validation Experience for the Colombian Power System

Neby CASTRILLÓN, Jaime PINZÓN, Juan GONZÁLEZ, Maria ZAPATA, Camilo MORENO
XM

Comprehensive Analysis of Colombian Power System Oscillations

Juan GONZÁLEZ, Neby CASTRILLÓN, Victor MEZA
XM

Evaluation of the robust operation of a diesel Generator Pool in new proposed Data Center electrical topology considering specific Generator manufacturer

Georgios KARVELIS¹, Christos AGATHOKLEOUS¹, Vassilis BAKOLAS¹, Drazena BROCILO², John WILTSHIRE², Salver CORHODZIC²
¹PROTASIS SA, Greece; ²META, USA

Enhancing Dynamic Performance Validation of Transient Stability Models using Argentina’s Phasor Measurement Units

Nicolás DE SAN JUAN, Félix GALLEGO, Trinidad UBICI
CAMMESA

Non-Intrusive Validation of Generator Parameters in Grid Modernization: Leveraging WAMS Data and PSO Optimization

Yossawin BUREETAN, Kantitat SASOMPHOLSAWAT, Agapol PUKPRAYURA, Witchaya PIMJAIPONG
Electricity Generating Authority of Thailand (EGAT), Thailand

Assessing the dynamic performance provision of a VSC-HVDC Interconnector on the Frequency and Angle Stability of a Low Inertia Isolated Power System

Melios HADJIKYPRIS, Georgios KOUVAROS, Andreas ARMENAKIS
Electricity Authority of Cyprus
EMT-Based Machine Learning Model for Fault Ride-Through Assessment in Type IV Offshore Wind Turbine Generators

Gabriel Miguel Gomes GUERREIRO¹, Ranjan SHARMA¹, Frank MARTIN¹, Guangya YANG²
¹SGRE; ²Technical University of Denmark (DTU)

Scalable Neural Dynamic Equivalence for Power Systems

Qing SHEN¹, Yifan ZHOU¹, Huanfeng ZHAO¹, Peng ZHANG¹, Qiang ZHANG², Slava MASLENNIKOV², Xiaochuan LUO²
¹Stony Brook University; ²ISO New England

Experimental Investigation of Commercial EV Chargers characteristics and Development of a Root Mean Square Model for Balanced Faults

Muneki MASUDA, Hayato SATOH
Central Research Institute of Electric Power Industry

Containerization of Real-Code Models for Simulation of Power Electronic Devices

Alejandro DUQUE - AFRY

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Rong GUO - TransGrid Solutions

PS2 - POWER QUALITY (PQ) AND ELECTROMAGNETIC COMPATIBILITY (EMC) ANALYSIS IN THE ENERGY TRANSITION: CHALLENGES, OPPORTUNITIES AND ADVANCES

Sensitivity analysis methods for wind farm harmonic studies

Benoît DE FOUCAUD, Xavier-Marie VIEL
RTE, France

Influence of Composition-Dependent Load Modelling on System-Wide Harmonic Impedance Characteristics

Peter BONINO, Samantha DEENEY, David ROOP
Mitsubishi Electric Power Products, Inc., United States of America
Real Time Geomagnetic Disturbance Analysis of Bulk Power System Grid using Geoelectric Field Grid Maps
Krishnat PATIL1, Christopher BALCH2
1Siemens Power Technologies International, United States of America; 2CIRES & NOAA Space Weather Prediction Center, United States of America

Estimation of Harmonic Exponent Summation Factors for Type 3 DFIG Wind Turbines
Amir KAZEMI, Jagdeep KAUR
GE Consulting Services, United States of America

Emission and Aggregation Characteristics of Some End Use Loads Sold in the United States
Gaurav SINGH, Jason JOHNS
Electric Power Research Institute (EPRI), United States of America

Voltage unbalance in overhead lines with EHV and HV circuits combined in the same tower
Jeroen VAN WAES1, Frederik GROEMAN2, Tam MAI2, Kees KOREMAN2
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Independent Insulation Group Sweden AB, Sweden

Post-Energy Transition Voltage Dips Assessment: A Dutch Transmission Network Case Study
Roozbeh TORKZADEH1, Jeroen VAN WAES2, Sjef COBBEN2
1Eindhoven University of Technology; 2TenneT TSO BV and Eindhoven University of Technology
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David OYEDOKUN
University of Cape Town

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Hitachi Energy Sweden AB, Sweden

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1EirGrid; 2 University College Dublin

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Miguel P. DE CARLI, Leonardo O. GRANDER
Brazilian NC of CIGRE, Brazil; Eletrobras CGT ELETROSUL

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TEPCO HD, Inc., Japan

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1National Research University «MPEI», Russian Federation; 2RPC ELNAP Ltd., Russian Federation

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HATCH, Australia
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<td>1KAPES, Republic of Korea; 2GE Grid Solutions, United Kingdom; 3KEPCO, Republic of Korea</td>
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PS3 - INSULATION CO-ORDINATION AND LIGHTNING INTERFERENCE ANALYSIS: CHALLENGES, OPPORTUNITIES AND ADVANCES

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Keywords: ATP, Grounding Grid, Lightning stroke, Soil Resistivity, Transmission Line Approach (TL), Frequency content, Uniform Soil

Effect of frequency content on the effective area of grounding grid at uniform soil resistivity
Adel Z. EL DEIN1, Sara YASSIN OMAR2
1Aswan University, Thebes Technological University; 2Upper Egypt Electricity Distribution Company

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Manuel MARTINEZ-DURO
EDF, France

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Jeffrey WISCHKAEMPER, B. Don RUSSELL, Carl BENNER, Karthick MANIVANNAN
Texas A&M University, United States of America

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Francesco PALONE
TERNA, Italy

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F. NASIRPOUR1, B. BEHDANI1, A. HEIDARY1, M. GHAFFARIAN NIASAR1, F. GHASSEMI2, K. VELITSIKAKIS3, M. VAN RIET4, M. WILKINSON5, M. VAN DER MEIJDEN3, S. NAUTA4, I. TANNEMAAT3, J. VEENS5, M. POPOV1
1Delft University of Technology, Faculty of EEMCS; 2National Grid Electricity Transmission plc; 3TenneT TSO B.V.; 4Alliander N.V.; 5Royal SMIT Transformers B.V.
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K. VELITSIKAKIS, I. TANNEMAAT
TenneT TSO B.V.

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Overvoltages with high harmonics when connecting step-up transformers in a pumped-storage power plant: A case study

Marcel STOECKL1, Florian BRANTSCHEM2, Romain BIRBAUM3, Cecile JOST3, Yves PANNATIER3, Georg KOEPP1
1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2Alpiq SA, Switzerland; 3Swissgrid AG, Switzerland; 1HYDRO Exploitation SA, Switzerland; 2self employed, Switzerland

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Simplified Methods and Models for Calculation of Switching Overvoltages on Transmission Lines including Effects of corona Discharges

Jan LUNDQUIST
Independent Insulation Group Sweden AB, Sweden

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Edgar RIBEIRO1, Angélica ROCHA2, Alberto DE CONTI3
1Brazilian NC of CIGRE, Brazil; NSA Consultoria e Informática LTDA; 2ATG Engenharia LTDA; 3Universidade Federal de Minas Gerais

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Keywords: Climate change, Lightning, Transmission Line

Climate Characterization and Historical Changes in Density and Intensity of Lightning around the 500 kV Bacabeira-Parnaíba Transmission Line

Rafael SILVA ALÍPIO1, Ana Clara MARQUES2, Pedro REGOTO3, Luciano RITTER3, Euro PINTO DE ALMEIDA4, William MEJIA5, Fernando DINIZ2, Thiago Luiz FERREIRA2, Fabian ROJAS2, Oscar GONZALEZ5
1Brazilian NC of CIGRE, Brazil; Cefet-MG University; 2Argo Energia; 3Climatempo; 4Consultant; 5Enlaza GEB

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Voltage Scaling Phenomenon in Isolated Ground Systems – Approach and Proposal for Mitigation Analysis of a Real Case in Brazil

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1Brazilian NC of CIGRE, Brazil; UNICAMP University; 2ARGO Energia
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Akiyoshi TATEMATSU¹, Yoshihiro BABA¹, Toshiaki UEDA², Toshihiro TSUBOI³, Soichi MORIGUCHI⁴
¹Central Res. Inst. of Electric Power Industry, Japan; ²Doshisha University, Japan; ³Daido University, Japan; ⁴Tokyo Electric Power Company, Japan; ⁵Chubu Electric Power Grid Co, Inc., Japan

Effect of cable sheaths on grounding performance of wind power plants in high frequency region

Melih GÜNERI¹, Bora ALBOYACI²
¹Kratis Engineering Türkiye; ²Kocaeli University Türkiye


William Gonzalo FLORES RUIZ¹, Jaimis S. LEON COLOQUI², Jose PISSOLATO FILHO²
¹National University of Engineering, Peru; ²State University of Campinas, Brazil

Transient switching mitigation in 115kV offshore platforms sensitive loads by introducing controlled switching device in three-phase gang-operated breakers

Nabil FARES¹, Thaiban RAJAB²
¹Saudi Aramco, KSA; ²Saudi Aramco, KSA

POWERGRID Experience on Insulation Coordination of High Voltage Substations Located at High Terrain and Snow Bound Area

Kiran Singh SINGH, Pankaj Kumar KUMAR, Rakesh Kumar KUMAR, Naveen Srivastava SRIVASTAVA
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Ferro Resonance in 765 KV Overcompensated Transmission Lines

Dr Subir SEN, B.B MUKHERJI, Mr ABHISHEK, G.A. SHINDE*, Pradeep PATIL, Pankaj MAHATA, Ashish SHARMA
POWERGRID Corporation of India Ltd, India

Measurement of lightning current circulating in line arresters and through the transmission line tower

Silvia SINČIĆ¹, Ivo UGLEŠIĆ², Alan ŽUPAN¹
¹Croatian Transmission System Operator (HOPS), Croatia; ²Faculty of Electrical Engineering and Computing University of Zagreb, Croatia

Modelling of Flashover on Insulator Strings of Overhead Lines Due to Lightning Overvoltages

Bozidar FILIPOVIC-GRICIC¹, Nina STIPETIC¹, Franjo VUKOVIC¹, Dalibor FILIPOVIC-GRICIC²
¹University of Zagreb Faculty of Electrical Engineering and Computing, Zagreb, Croatia; ²Končar – Electrical Engineering Institute Ltd., Croatia
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Leonardo PORRAS¹, Ronald DICKSON¹, Guillermo FONSECA¹, Daniel ARANGUREN²
1ISA Intercolombia; 2Keraunos SAS

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1Smart Wires Inc; 2ISA Interconexión Eléctrica

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**Future Electricity Market Design to Ensure Resilient and Efficient Operations**
Jan VAN PUTTEN¹, Greg THORPE², John GING³, Vivek PANDEY⁴, Amjad ANVARI-MOGHADDAM⁵, Danny KLAAR¹, Gourav MUKHERJEE¹, Juan BOGAS⁵
1TenneT TSO B.V.; 2Oakley Greenwood; 3Eirgrid; 4Posoco; 5OMIE; 6Aalborg university

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Zhenhui LI, Vincent WISE, Mary FU
Energy Market Company, Singapore

Challenges and future prospects for Japanese wholesale electricity market and balancing market
Hiroki SAKAI¹, Kenichi SUGAHARA², Yuki KATAOKA¹, Akihiro MAEKAWA³, Ken FURUSAWA³
1Chubu electric Power Grid Co., Inc., Japan; 2Chubu electric Power Co., Inc., Japan; 3Kansai Transmission and Distribution, Inc., Japan; 4Central Research Institute of Electric Power Industry, Japan
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S K SOONEE¹, V K AGRAWAL², Prof. Anjan BOSE³, S S BARPANDA⁴, R K PORWAL⁴, S C SAXENA⁴, M K AGRAWAL⁴, Vivek PANDEY⁴, S K VERMA⁴, Bindiya JAIN⁴, G M Sharat CHANDRA⁴, Sourav SAHAY⁴  
¹Ex-CEO, Grid-India, India; ²South Asia Regional Energy Partnership, India; ³Washington State University, USA; ⁴Grid Controller of India Limited, India

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Harish Dora MONGAM*, Phanisankar CHILUKURI  
Grid-India, India

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Muna AL JABRI  
Muscat Electricity Distribution Company, Oman

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**Can Demand Side Management in the Sectors of Industry and Services Increase Market Resilience?**  
Stephan KIGLE¹, Nadja HELMER², Quirin STROBEL¹, Peter WIRTZ³, Christiane GOLLING⁴  
¹FfE Munich & TUM, Germany; ²FfE Munich, Germany; ³RWTH Aachen University, Germany; ⁴50Hertz Transmission GmbH, Germany

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**Comparing the Co-Optimized and Market-Based Allocation of Cross-Zonal Capacity for the Exchange of Balancing Capacity**  
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Yanzhe REN¹, Yue ZHOU², Gengfeng LI¹, Zhaohong BIE¹  
¹Xi’an Jiaotong University, China; ²Cardiff University
Study on the effects of the flow-based approach in the Italian bidding zones capacity calculation
Luca LUZI
TERNA, Italy

Structuring the Coordination Across Transmission and Distribution to Support Value Stacking Scenarios Combining Multiple DER-Provided Grid Services
Tanguy HUBERT
Electric Power Research Institute (EPRI), United States of America

Dynamic Procurement of Reserves in New York Electricity Markets
Pradip KUMAR1, Matt MUSTO1, Nate GILBRAITH1, Rana MUWERJ1, Michael DESOCIO2
1New York Independent System Operator (NYISO), United States of America; 2Luminary Energy, United States of America

Optimizing Combined-Cycle Generators in PJM's Wholesale Electricity Markets Using a Hybrid Multiple Configuration Resource Model for Enhanced Flexibility
Anthony GIACOMONI, Danial NAZEMI
PJM Interconnection, United States of America

Finding Flexibility in Large Flexible Loads: Making Demand Equivalent to Generation in Wholesale Markets
Debra LEW1, Richard O'NEILL2, Erik ELA2, Mark AHLSTROM4
1Energy Systems Integration Group (ESIG), United States of America; 2Consultant, United States of America; 3Electric Power Research Institute (EPRI), United States of America; 4NextEra Energy Resources, United States of America

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Mazaher HAJI BASHI, Brendan O'SULLIVAN
EirGrid

The Idea of Fed-Balancing Energy Market, a Smart Use of Balancing Capacity Auction Results
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Analysis on the integration of new technology in the Brazilian electricity market – Offshore wind case

Solange DAVID1, Vinicius DAVID2
1Brazilian NC of CIGRE, Brazil; Consultant; 2Thymos Energia

Connection products in electricity networks

Eivind GRAMME1, Selina KERSCHER2
1Lede Norway; 2University of oviedo Spain

Forecasting Model of Electricity Production from Hydroelectric Sources with Long Short-Term Memory (LSTM) Networks

İnayet Özge AKSU, Tuğçe DEMIRDELEN
Adana Science and Technology University Türkiye

Implementation of Virtual Power Purchase Agreements to Support Carbon Neutral Investments in the Russian Electricity Market

Vladislav BEREZOVSKY1, Anna PAVLYCHEVA2, Sergey GAFAROV3, Andrey SVIRIDOV3, Victor BALYBERDIN4
1Carbon Zero LLC, Russian Federation; 2University of Chicago, USA; 3Association «NP Market Council», Russian Federation; 4SKM Market Predictor AS, Norway

Impact of Carbon Pricing on Wholesale Electricity Prices and Energy Transition Scenarios in Russia

Vladislav BEREZOVSKY1, Nikita IVANOV2, Tatiana REMIZOVA3, Ljubov CHERNEY4, Dmitry KOSHELEV5

Connection agreements subject to limitations for renewable generation and storage facilities in Greece

Apostolos PAPAKONSTANTINOU, Evangelos CHATZISTYLIANOS, Georgios PSARROS, Stavros PAPATHANASSIOU
National Technical University of Athens (NTUA), Greece

Not Drowning, Waving! Australia’s Net Zero Ambitions Enabled by multiple approaches? Or drowning in complexity?

Jacqueline BRIDGE, Jonathan DENNIS
Powerlink Queensland, Australia
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<td>Keywords: Distributed Energy Resource (DER), Distributed Energy Trading Market, Demand Side Electrical Value, Energy Management System (EMS), Distribution locational Marginal Price (DLMP), Value of Lost Load (VoLL)</td>
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**Mechanisms for Trading the Electrical Value of the Demand Side to Promote the Usage of Distributed Energy Resources**

Takeshi YAMASHITA¹, Hideki KIBATA¹, Tokunari ANAI¹, Hiroshi OKAMOTO²

¹Tokyo Electric Power Company Holdings, Inc., Japan; ²TEPCO Power Grid, Inc., Japan

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**Electricity Market in India- Present and Future**

C. Rethi NAIR*, DVS PHANEENDRA, N AHMAD, S MUKHERJEE, T. SRINIVAS, S P KUMAR

Grid Controller of India Ltd, India

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**Introduction of the Operational Core Day-Ahead Flow-Based Capacity Calculation and Market Coupling through Active Constraints and Price Spread**

Ferenc NAGY, Melinda NAGY, Luca TÓTH, Ágnes TAKÁCSNÉ ESZE, Ákos ARNOLD

MAVIR Ltd.

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**Key Initiatives, Regulatory Framework & Challenges to attain the ambitious target of 500 GW non-fossil fuel energy by 2030 in India**

Priyanshi AGGARWAL*, Prashant GARG, Sheikh SHADRUDDIN, Rajiv PORWAL

Grid-India, India

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**State Tariff Design using Regulatory Sandbox Approach for Enhancing Renewable Energy Demand**

Reji Kumar PILLLAI*, Reena SURI, Anand Kumar SINGH

ISGF, India

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**Initiatives to develop dedicated market segments for Green Energy in India**

Sonali MANGAL*, S. C. SAXEMA, Subhendu MUKHERJEE, Manisha SUBHLAXMI, Datta GADEKAR, Rohit HISARIYA

Grid-India, India

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**Market Design And Regulatory Enablers For The Evolving Indian Electricity Market**

Dr. Rajib K MISHRA*, Rajesh CHERAYIL

PTC India Limited, India

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**Coal phase out in Chile: lessons from an ongoing process**

Javier BUSTOS-SALVAGNO

CIGER - Universidad del Desarrollo, Chile
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Nan SHANG
Energy Development Research Institute, China Southern Power Grid

Automated Market Bidding for Battery Energy Storage Systems

Faeza HAFIZ1, Iiro HARJUNKOSKI2, Mohamed EISSA3, Elisabetta VALLARINO3, Silvia PICERNO3
1Hitachi Energy Research, United States of America; 2Hitachi Energy Research, Germany; 3Hitachi Energy, Italy

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1Brazilian NC of CIGRE, Brazil; CCEE; 2Hitachi Energy
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¹Association NP Market Council, Russian Federation; ²SKM Market Predictor AS, Norway

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¹Progressive Grid Solutions Pvt Ltd, India; ²Electric Power Research Institute (EPRI), USA

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¹GCC Interconnection Authority, KSA; ²GCC Interconnection Authority, KSA

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Electricity Generating Authority of Thailand (EGAT), Thailand

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Jovanio Silva dos SANTOS
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PS1 - FLEXIBILITY MANAGEMENT IN DISTRIBUTION NETWORKS

Application of a 50MW/100MWh energy storage system with grid-forming converters
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Case Studies of AC & DC Hybrid Power Distribution Grid Solutions
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South China University of Technology, China

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Electric Vehicle integration on the LV grid for ancillary services provision: an experimental case study leveraging 2nd generation smart meters in Italy
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Local Network Management and Distributed Generation Curtailment Avoidance through Domestic Demand Response
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¹SP Energy Networks UK; ²Octopus Energy UK

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Electric Power Research Institute (EPRI), United States of America

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Tanguy HUBERT
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Jessica LAU, Yashar KENARANGUI, Beth CHACON
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<td><strong>Ensuring ADMS Functionality and Flexibility with Hardware-in-the-Loop Verification</strong></td>
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<td>Josh SNODGRASS⁵, Christopher HUFF⁶, Aleksandar PARMAKOVIC⁷</td>
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<td>⁵POWER Engineers, Inc., United States of America; ⁶Pacific Gas and Electric, United States of America; ⁷Schneider Electric, Serbia</td>
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<td><strong>Business Cases for Energy Storage Project at Distribution Level Participating in European Electricity Markets with Examples of Real Projects</strong></td>
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<td>Takashi USAMI¹, Hamideh BITARAF³, Ernesto SORESSI³</td>
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Portable Energy Storage Systems as an Alternative to Reinforcement in Distribution Networks
Carlos E UGALDE-LOO, Isaac YAMAMOTO, Pranaynil SAIKIA
Cardiff University UK

Evaluating the Impact of New Technology Deployment on Future Congestion of LV Distribution Grids
Na LI¹, Anton ISHCHENKO², Simon TINDEMANS¹, Kenneth BRUNINX¹
¹Delft University of Technology; ²Phase to Phase BV

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¹Siemens, Spain; ²Siemens, Portugal; ³EDA, Portugal

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Malusi MATHONSI
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Dongjun HAN, Seungwoo NAM, Dongjun WON
Inha University, Korea, Republic of (South Korea)

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Vyacheslav VORONIN¹, Fedor NEPSHA²
¹T.F. Gorbachev Kuzbass State Technical University, Russian Federation; ²RTSoft Smart Grid, LLC, Russian Federation
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Merkebu Z. DEGEFA1, Gunnar VIST2, Mathias F. ELIASSEN3, Ashild VATNE4, Rubi RANA1, Line BERGEFJORD5, Iver BAKKEN SPERSTAD1, Sigurd H. JAKOBSEN1, Raymundo E. TORRES-OLGUIN1
1SINTEF Energi As Norway; 2Heimdall Power Norway; 3Kongsberg Digital Norway; 4Ashild.Vatne@elvia.no; 5BKK Norway

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Gerd KJØLLE1, Oddbjørn GJERDE1, Merkebu Z. DEGEFA1, Stig SIMONSEN2, Mariona ZHURI2, Katrine UTVIK3
1SINTEF Energy Research Norway; 2Lede Norway; 3Elvia Norway

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Heidi S. NYGÅRD1, Ruth OLERUD1, Petter LUNDE2
1Norwegian University of Life Sciences (NMBU) Norway; 2Tronrud Engineering Norway

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Ursula KRISPER
Elektro Ljubljana, d.d.

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Ersa AYDIN, Belgin TURKAY, Cenk ANDIC
Istanbul Technical University Türkiye

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Douglas WILSON1, Marta LATERZA1, Marcos SANTOS1, Richard DAVEY1, Ian MACPHerson2, Mark MORRISON2, James YU2
1GE Vernova UK; 2SP Energy Networks UK

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1Hitachi Energy Research, Germany; 2Hitachi Energy, Switzerland; 3Hitachi Energy, Italy
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Peter WALL1, Douglas WILSON1, Lihong HAO1, Andreas GLATZ2, Yusen FEI1, Ivan MARTIN1, Richard DAVEY1, Boris YAZADZHIYAN2, James MILLS3, Mayamiko HARA2, Tam SOKARI-BRIGGS2, Tim MANANDHAR2
1GE Vernova UK; 2UK Power Networks UK

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Stephen SPROUL1, John GLASSMIRE2, Francesco BACCINO3, Pablo ALMALECK3
1Hitachi Energy, Australia; 2Hitachi Energy, USA; 3Hitachi Energy, Italy

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1Kansai Transmission and Distribution, Inc., Japan; 2Osaka University, Japan

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Rajil SRIVASTAVA*, Manish Kumar TIWARI, Rajesh Kumar PANDA, Sujoy SAHA
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Distribution Sector Reform in Odisha (India) – A Challenge and Sincere Effort to Turn Around the Distribution Sector into An Operationally & Financially Viable Sector

Sushanta Kumar Ray MOHAPATRA
Odisha Electricity Regulatory Commission, India

Flexible Marketplace for Green Energy Trading Amongst Local Energy Communities

Reji Kumar PILLAI*, Reena SURI, Parul S
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István TÁCZI1, Kristóf Péter JUHÁSZ2, István VOKONY3, Bálint HARTMANN4
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| Peter NOGLIK¹, Marco GIUNTOLI², Katarina KNEZOVIC³, Antony HILLIARD⁴, Maximilian DAUER⁵, Maximilian ROSE⁶, Michael GRATZA⁷, Andreas SCHLERETH⁸, Robert SCHMIDT⁹, Stephan RUPP⁵, Sebastian BRUSKE⁷, Alexander MAGES⁴
| ¹Hitachi Energy AG, Germany; ²Siemens AG, Germany; ³TenneT TSO GmbH, Germany; ⁴Fraunhofer IPA, Germany; ⁵Hitachi Energy Research RWTH Aachen, Germany; ⁶RWTH Aachen, Germany; ⁷Maschinenfabrik Reinhausen GmbH, Germany; ⁸Schleswig-Holstein Netz AG, Germany; ⁹Hitachi Energy Research, Switzerland; ¹⁰Hitachi Energy Research, Canada

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| Topics: C6 PS1 - Flexibility Management in Distribution Networks
| **A New Wide Area Protection Scheme for Active Distribution Network**
| Khaled AL-MAITAH¹, Abdullah AL-ODIENAT²
| ¹EDCO; ²Mutah University

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| A New Wide Area Protection Scheme for Active Distribution Network
| Khaled AL-MAITAH¹, Abdullah AL-ODIENAT²
| ¹EDCO; ²Mutah University

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| Leonie RIEDL¹, Martin BRAUN¹, Philip HEHLERT²
| ¹Fraunhofer Institut für Energiewirtschaft und Energiesystemtechnik IEE & Universität Kassel, Germany; ²Georg-August-Universität Göttingen, Germany

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| Jelena PONOCKO, Rebecca THRELFALL, Josephine O'BRIEN, Shengji TEE, Russell BRYANS, Malcolm BEBBINGTON
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| **Energy Storage System Design Considering Multiple Revenue Streams for Large Scale Solar in Malaysia**
| Junainah SARDI¹, Wan Syakirah WAN ABDULLAH², Hazriq Hakimi YAACOB², Ahmad Amirul Hakim MOHD HAMID²
| ¹Universiti Teknikal Malaysia Melaka; ²Tenaga Nasional Berhad

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| **Investigating the Capabilities of Weight-Based Gravity Storage for Delivering Ancillary Services**
| Alexander SIEMSEN¹, Rasmus VIG JENSEN¹, Lisa CALEARO¹, Jill MACPHERSON²
| ¹Ramboll Danmark A/S; ²Gravitricity
The challenge of smooth cooperation of hydroelectric Turbines with thermal Units to provide FCR and aFRR in a Non-Interconnected Island
Anastasis TSOUUMANIS, Stefanos KOKKINELIS, Konstantinos NATSIS, Stavros PAPATHANASSIOU, Despoina KOUKOULA, Charalampos PAPPAS, Eleni LAMPRINIDI, Theodora PATSAKA
1PPC Renewables S.M.S.A., Greece; 2Hellenic Electricity Distribution Network Operator S.A., Greece; 3National Technical University of Athens, Greece

Impact of hybrid generation and storage system, including virtual inertia, on the grid connection for planning studies
Jorge PÁRRAGA ORTEGA
ITE Instituto Tecnológico de la Energía – UPV Universitat Politècnica de València, Spain

The Issues for Japan’s Future Distribution Grid
Yuki KAWACHI
Kansai Transmission and Distribution, Inc., Japan

The Use of Thermal Energy Storage from Residential Hot Water Systems for Flexible Network Demand Management
Wei Jian CHAN
Energex & Ergon Energy (part of Energy Queensland), Australia

How to detect and mitigate electricity theft in a South African distribution network in spite of the inadequacy of the network to be a fully smart system
Ndoro NETSHIPALE
Eskom Holdings SOC Ltd, South Africa

Classification of Highly Resonant Wireless Charging Techniques for Light EVs and Similar Low Applications
Eman GOMAA, Ahmed SHAWKY, Mohammed SAAD, Mohammed ORABI
1Upper Egypt Electricity Distribution Company; 2Aswan University

A Hybrid Networking Scheme With Grid-forming and Grid-following Converters for Resilient Active Distribution System
Zhuhu HUA, Lei SHANG, Xuzhu DONG
Wuhan University, China
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**Black Start Operation of Grid-Forming Converters Based on Generalized Three-phase Droop Control Under Unbalanced Conditions**

Zexian ZENG, Prajwal BHAGWAT, Maryam SAEEDIFARD, Dominic GROSS

1Georgia Institute of Technology, United States of America; 2University of Wisconsin-Madison, United States of America

**Soft Open Point at Bermeo substation to improve distribution system reliability and hosting capacity**

Markel ZUBIAGA, David SANTOS, Eneko OLEA, Javier CHIVITE, Javier CAÑAS, Raul PEÑA

1Ingeteam Research Institute, Spain; 2Ingeteam P. Technology, Spain; 3Iberdrola, Spain

**Semiconductor circuit-breaker based on RB-IGCT to protect LVDC microgrids**

Marcel STOECKLI, Antonello ANTONIAZZI, Thomas MASPER, Thorsten STRASSEL, Umamaheswara VEMULAPATI, Christian WINTER

1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2ABB, Italy; 3ABB, Switzerland; 4Hitachi Energy, Switzerland

**Synthesis of Adaptive Control System of Converter-Interfaced Generation Based on a Virtual Synchronous Generator**

Alisher ASKAROV, Aleksey SUVOROV

1National Research Tomsk Polytechnic University, Russian Federation; 2Energy Research Institute of the Russian Academy of Sciences, Russian Federation

**Evaluation of the Effect of Dynamic Pricing on EV Charging to Voltage Variation in Distribution Lines**

Toko MANNARI, Hiroyuki HATTA, Masahito TAKAHASHI

Central Research Institute of Electric Power Industry (CRIEPI), Japan

**Development of GFM Inverters for Increased Penetration of Variable Renewable Energy**

Yusuke NISHIDA, Teru MIYAZAKI

Tokyo Electric Power Company Holdings, Inc., Japan

**Volt-Var Technique Utilization for Voltage Control in Distribution Networks with Smart Inverters – A Case Study of Jordan**

Walaa THIABAT, Mu'men BODOOR, Mahdi AL-SHATNAWI, Abdalrheem JAWARNEH, Mohammad NASER

IDECO
Average Models and Characteristics of Current-Controlled Converters for Fault Analysis in DC Microgrids
Jin-Su KIM¹, Ji-Song HONG¹, Young-Bin CHO¹, Seok-Chan LEE², Sang-Yun YUN²
¹LS ELECTRIC Co., Ltd., Korea, Republic of (South Korea); ²Chonnam University, Korea, Republic of (South Korea)

Voltage Rise Suppression Strategies for Utility-Scale Solar Photovoltaic-based Microgrids
Krit KONGURAI
Electricity Generating Authority of Thailand (EGAT), Thailand

Low Voltage Arcing and Fire Testing: Experiments to Compare Arc Flash and Fire Hazard Between LVAC and LVDC Enclosures Faults
Michael GIBSON¹, Andre CUPPEN¹,², Nirmal NAIR¹
¹University of Auckland, New Zealand; ²PowerCo Limited, New Zealand

Smart Transformer Real-time Simulation Model with External Control Script Implementation and Performance Analysis
Ville OLLIKAINEN
VTT Technical Research Centre of Finland

Design and Simulation of Dominion Energy’s AC Microgrid
Genesis ALVAREZ¹, Robert ALLISON¹, Lung-An LEE¹, Justin SMITH¹, Katelynn VANCE¹, Lou COLANGELO², Hermann KOCH², Peter GROSSMAN², Adam ADDESSO²
¹Dominion Energy, United States of America; ²RCM Technologies, United States of America

Energy Management System to Improve Resilience in Islanded Interconnected Microgrids
Fundiswa MTHETHWA
Eskom

The Design of an Islanded Microgrid in the Kalahari Desert of South Africa: Noenieput Settlement Off-grid Electrification
Soni M
Eskom SOC Ltd
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<td><strong>Protection scheme for single pole to ground faults in multi-terminal MMC-MVDC grid utilizing sequential tripping</strong></td>
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<td>Gvan Chun CHO¹,², Seul-Ki KIM¹, Gyeong-Hun KIM¹, Jihui HWANG¹</td>
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<td>¹Korea Electrotechnology Research Institute, Korea, Republic of (South Korea); ²National Research University ‘Moscow Power Engineering Institute’, Russia</td>
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<td><strong>Detection of Open Conductor Fault using Multiple Measurement Factors of RTUs in Active Distribution Networks with DERs</strong></td>
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<td>JiSong HONG</td>
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<td>Hideo ISHI¹, Naoto HIGA², Tomohiro SHIOHAMA³, Satoru NAKAMURA³, Kiyomasa KOHATSU⁵</td>
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<tr>
<td><strong>Best Investment Planning of Microgrid Networks: Jordan Case Study</strong></td>
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<td>Suad S. ALMATTAR</td>
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<td><strong>A model for future load profiles considering extreme weather conditions</strong></td>
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<td>Michael DAHMS, Torsten SOWA</td>
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<td>AMPERIAS GMBH, Germany</td>
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Optimal Service Restoration Using Distributed Generations After Blackout in Distribution Networks
Saehwan LIM¹², Jin-Oh LEE¹, Hyeong-Jun YOO¹, Gyeong-Hun KIM¹
¹Korea Electrotechnology Research Institute, Korea, Republic of (South Korea); ²Yonsei University

Achieving successful community engagement in the evolving power system landscape: A case for micro- and mini-grids
Tshwanelo RAKAIBE
Cigre Southern Africa, South Africa

A Combined Prepaid and Post-Paid Scheme for Non-Connected Zones and Migration from a Conventional Energy-Based Tariff to an Availability Solution in Terms of Time
Luis BERRIO, Jimena RAIGOZA, Catalina GARCÉS, Ángela BURITICÁ, Juan FRANCO, Rafael LUNA
EPM

Validation of the Engineering for a Protection System in a Microgrid at the Universidad del Valle Campus in Colombia
Andres DÍAZ, Edison FRANCO, Eduardo GOMEZ
Universidad del Valle

Impacts and Challenges of the Integration of Connected to the Grid-Microgrids: Colombian Case
Luisa ESCOBAR, Eduardo GÓMEZ
Universidad del Valle

An automatic frequency control system for off-grid power systems with energy storages
Gleb NESTERENKO¹, Vyacheslav ZYRYANOV²
¹SO UPS, JSC «Branch Regional Dispatching Office, Energy System of Novosibirsk Region, Altai Territory and the Altai Republic, Russia; ²Novosibirsk State Technical University, Russia
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<td>Topics: D1 PS1 - Testing, Monitoring and Diagnostics</td>
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| **A High Performance Differential Acoustic Emission Sensor for Partial Discharge Detection**
Yongling LU¹, Zhen WANG¹, Chengtao LUO², Yang SONG²

¹State Grid Jiangsu Electric Power Company Ltd. Research Institute, China; ²Shanghai Jiao Tong University, China |

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| **Differential Pressure Method for Measuring Gas Leakage of Dynamic Sealing Units in GIS**
Zhiqiang TAO¹, Liang SONG², Lu LIU¹, Manuel NAEF², Luopeng LIU², Yang WANG¹

¹Hitachi Energy Research; ²Hitachi Energy High Voltage Technology Center |

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| **Keywords:** UHF monitoring, narrow band system, Power Transformers, noisy environment, SF6-alternatives
**Use of narrow band UHF monitoring system for Power Transformer and GIS including SF6-free solution in laboratory and site environments**
Raphael LEBRETON, Sebastien LOUISE

GE Vernova, France |

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| **Testing, Measuring and Diagnostic Partial Discharge: use case examples in MV applications**
Marco RIVA

ELDS Technology Centre – ABB spa Italy |

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| **Use of state observer and load cell sensors for monitoring overhead line ice sleeve overload and conductor temperature**
Lorenzo PAPI

TERNA, Italy |

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| **Compensating Losses in On-line HFCT Partial Discharge Measurements under High Load Current Conditions**
Kai Xian LAI, Javan Chun Fong LEE, Bing Hong LECK, Hongyan CAO, Ranjan THIRUCHELVAM, Vincent Kum Kong WONG

SP Group Singapore |

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| **Keywords:** Dielectric Frequency Response (DFR), Gas Chromatography, High Molecular Weight Acids, Low Molecular Weight Acids, Water
**Determination of Low and High Molecular Weight Carboxylic Acids by Chromatography and Possible Implications for Dielectric Frequency Response Measurements**
Lance R. LEWAND, Ronald HERNANDEZ, Zach HOLLAND

Doble Engineering Company, United States of America |
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<td><strong>Application of Performing DFR on Bushings: Utility Perspective</strong></td>
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<td>Poorvi PATEL1, Peter ZHAO2, Varun GOYAL2, Timothy RAYMOND1</td>
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<th>D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers</th>
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<tr>
<td><strong>Topics:</strong></td>
<td>D1 PS1 - Testing, Monitoring and Diagnostics</td>
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<td><strong>Pseudo passive sensoring of partial discharges of electrical assets in multiple and remote locations</strong></td>
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<td>Daniel BLANCO1, Fco. Javier DE PAZ2, Rafael FUERTES2, Ricardo GÓMEZ2, Ricardo REINOSO1, Gonzalo DONOSO1, Elena NOGUEROLE1</td>
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<td>1Red Eléctrica, Spain; 2DXIoT Systems, Spain</td>
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Cyclic Corrosion Testing Under Load for HV Disconnectors
Hélène GAUTHIER, Catherine LE POSTEC
Hydro-Québec, Canada

Lifetime analysis and extended impulse and superimposed impulse voltage tests on a GIS voltage divider for HVDC applications
Marcel STOECKLI¹, Uwe RIECHERT²*, Erik SPERLING³, Andreas DOWBYSCH⁴
¹ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; ²Hitachi Energy, Switzerland; ³Omicron electronics, Switzerland; ⁴Technische Universität Dresden, Germany

Dissolved Gas On-line Monitor Based on Tunable Diode Laser Absorption Spectroscopy and Enhanced by Vacuum Extraction
Dmitriy VODENNIKOV¹, Alexander GUK¹, Artem KLIMCHUK², Mikhail BALANOV², Leonid POSPEEV²
¹PJSC ROSSETI, Russian Federation; ²Individual expert, Russian Federation

Monitoring of Seasonal Changes in the Concentrations of Chemical Markers Dissolved in Power Transformer Oil
Leonid DARIAN¹, Sergey ASOSKOV², Vladimir POLISHCHUK³, Roman OBRAZTSOV¹, Alexey MAKSIMCHENKO³
¹JSC «Technical Inspection UES», Russian Federation; ²LLC Gazprom Energo, Russian Federation; ³Joint Institute for High Temperatures of the RAS, Russian Federation

Mobile Diagnostic X-ray System for Inspection of High-voltage Equipment in Operation
Leonid DARIAN¹, Roman OBRAZTSOV¹, Oleg OZEROV²
¹JSC «Technical Inspection UES», Russian Federation; ²Dukhov Research Institute of Automatics

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Adriana DE CASTRO PASSOS MARTINS¹, Sheila SOUTHGATE DE OLIVEIRA², Alain François SANSON LEVY³, Arthur DE CASTRO RIBEIRO⁴, Alexandre R. MARTINS⁵
¹Brazilian NC of CIGRE, Brazil; CEMIG; ²Consultant; ³Consultant; ⁴Eletrobras CEPEL; ⁵Consultant

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Ivanka HOEHLEIN, Carolin SCHUETT, Zhe SHAN
Siemens Energy, Germany
Novel Space Charge Measurement System for Full-size XLPE cables under Actual Operating Voltage and Temperature Conditions
Shosuke MORITA1, Norikazu FUSE1, Takayuki MATSUBARA2, Yoshinao MURATA2, Yoshinobu MURAKAMI1, Naohiro HOZUMI3
1 Central Research Institute of Electric Power Industry, Japan; 2 Sumitomo Electric Industries Ltd., Japan; 3 Toyohashi University of Technology, Japan

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Yoitsu SEKIGUCHI1, Takashi KURIHARA2, Hiroaki MIYAKE3, Tatsuo TAKADA3
1 Sumitomo Electric Industries, Japan; 2 CRIEPI, Japan; 3 Tokyo City University, Japan

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Rainer FROTSCHER1, Eva KELEMEN2, Alexander ALBER1, Jim RIPPON2
1 Maschinenfabrik Reinhausen GmbH, Germany; 2 ALTALINK, L. P., Canada

Development and verification of an online method for determining the oil condition of on-load tap-changers and transformers
Andreas KURZ1, Roland GÖTZ1, Julia MASSMANN2, Johannes VEIT2
1 Maschinenfabrik Reinhausen, Germany; 2 Amprion GmbH, Germany

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Claus NEUMANN1, Maximilian VOGL2
1 Technical University of Darmstadt, Germany; 2 Vogl electronic, Germany

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Nitin SHINGNE*, Uday PUNTAMBEKAR, Satish CHETWANI
Electrical Research and Development Association (ERDA), India

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Marius GRISARU
Transformer oil tests independent consultant and educationalist at Transformer Academy, Israel

Partial discharge behaviour in GIS with C4-FN mixtures: Comparison of conventional and UHF measurement techniques
Johanna LINKE1, Uwe RIECHERT2, Stephan SCHLEGEIL, Willy JAROSZCZINSKY1
1 Technische Universität Dresden, Germany; 2 Hitachi Energy, Switzerland
Evaluation of the Dielectric Strength of Silicone Elastomers at DC Stress
Stefan KUEHNEL¹, Stefan KORNHUBER², Jens SEIFERT³, Jens LAMBRECHT⁴, Christiane BAER⁵
¹Hochschule Zittau/Görlitz, Germany; ²Wacker Chemie AG, Germany; ³Maschinenfabrik Reinhausen, Germany

Tests experiences of Temporary Over-Voltage for HVDC cable system
Dae-Jin PARK, Tae-Ho LEE, Sang-Taek PARK, Jin-Ho NAM, Sung-Yun KIM, Jung-Nyun KIM
LS Cable & System

Model To Estimate Solid Insulation Ageing in Power Transformers via Alcohol Based Chemical Indicators
Abhay CHAUDHARY, Dr Subir SEN, B.B MUKHERJEE, V K BHASKAR, Abhishek ABHISHEK, N K BHASKAR, Dr Satish KUMAR, Dr Arun Prakash UPADHYAY*
Power Grid Corporation of India Ltd, India

New Approach in Condition Monitoring of Power Transformers Oil Pumps
Sebastián LAURIA, Franco LEIVA, Agustín AVALOS, Andrés LANTOS
Laboratorio Dr. Lantos

High Insulation Power Factor in Power Transformer!!! Deep Diagnostic Approaches for Root Cause Analysis
Pongpon SINGKHAWAT, Anchalee TONG-IN
Electricity Generating Authority of Thailand (EGAT), Thailand

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Wutthipan PARIYOTHAI, Sirapa THONGDEE
Electricity Generating Authority of Thailand (EGAT), Thailand

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Filip STUCHAŁA, Paweł RÓZGA
Łódź University of Technology, Institute of Electrical Power Engineering, Poland

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Dmitry POLYAKOV
Omsk State Technical University, Russia
Several equations of state for SF6: how to avoid errors?
Nathalie BARNEL, Alain JEANMAIRE
EDF R&D, France

Characterization of the liquefaction properties of fluoronitrile mixtures by a thermodynamic experimental approach
Caterina TOIGO1, Antoine PEREZ1, Frank JACQUIER1, Alain GIORDET1, Michael INVERSIN2, Didier LASSERRE2
1 SuperGrid Institute, France; 2 RTE, France

Effect of temperature on the development and partial discharge characteristics of electrical trees under combined AC/DC voltage in epoxy resin
Yingman SUN1, Xuandong LIU1, Gaoyi SHANG1, Hao SUN1, Hao TANG2, Xining LI2
1 Xi'an Jiaotong University, China; 2 China Electric Power Research Institute, China

Modelling and decoupling of the dielectric response of silicone rubber composites used for outer insulation
Qian WANG, Ying ZHOU, Chao WU, Xidong LIANG
Tsinghua University, China

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Qiang FU1, Lei PENG1, Li ZHANG1, Chengxi FU2, Musong LIN1, Zhi LI1
1 Guangdong Key Laboratory of Electric Power Equipment Reliability, Electric Power Research Institute of Guangdong Power Grid Co., Ltd., China; 2 School of Energy and Environment, City University of Hong Kong, China

Study on Epoxy Resin Insulation Characteristics of Valve-Side Bushing in Converter Transformer Under Composite Voltage and Thermal Field
Hao SUN1, Xuandong LIU1, Wanbao SHI1, Yingman SUN1, Hao TANG2, Xining LI2
1 Xi'an Jiaotong University, China; 2 China Electric Power Research Institute, China

Study on water ingress characteristics of HTV silicone rubber
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1 Tsinghua University, China; 2 State Grid Jibei Electric Power Co. Ltd. Research Institute, China
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 Keywords: Resin Impregnated Paper (RIP), HVDC, reliability, DC voltage, breakdown value  

**Ageing behaviour of RIP material under several DC voltages and temperature**

Matthieu DALSTEIN¹, Laura DE FINA², Thanh VU-CONG¹, Franck JACQUIER¹, Armando PASTORE²  
¹SuperGrid Institute, France; ²GE RPV, Italy

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 Topics: D1 PS2 - Materials for Electrotechnical Technical Purposes and Modelling  
 Keywords: mineral oil, ester oil, biodegradable hydrocarbons, thermal ageing, ageing markers  

**Alternative liquids for transformers: thermal ageing comparison and ageing markers correlation**

Anthony JEANNETON¹, Christophe PERRIER¹, Abderrahmane BEROUAL²  
¹GE Grid Solutions, France; ²Ecole Centrale de Lyon, France

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D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers

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 Keywords: Dielectric properties, liquid nitrogen, resistive superconductive, pre-conditioning, DC applications  

**Dielectric properties of liquid nitrogen for the design of Resistive Superconductive Fault Current Limiters**

Diego BRASILIANO, Christophe CREUSOT, Nicolas DEVEAUX, Alain GIRODET, Laurent MATHRAY  
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 Topics: D1 PS2 - Materials for Electrotechnical Technical Purposes and Modelling  
 Keywords: Interfacial Dielectric Strength, Breakdown Strength, Cable Joint, Compatibility  

**Evaluating the Interfacial Compatibility of Dielectric Materials for Cable Joints**

Paul MWASAME¹, Xiaoshuang WEI¹, Timothy PERSON¹, Saurav SENGUPTA¹, Michael CHERRY¹, Wenbo XU¹, Joel CERVA¹, Yuanqiao RAO¹, Junsi GU², Robert DRAKE²  
¹Dow Chemical, United States of America; ²Dow Chemical, United Kingdom

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D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers

 Topics: D1 PS2 - Materials for Electrotechnical Technical Purposes and Modelling  
 Keywords: accelerated testing, thermal aging, ethylene vinyl acetate  

**Investigation of Aging of the Polymer Cable Composition Based on Ethylene Vinyl Acetate**

Darya BOLOTINA¹, Alexander KONONENKO¹, Alexey POMERANTSEV², Alexander TSIKANIN¹  
¹RISI JSC, Russian Federation; ²RISI JSC, FRCCP RAS, Russian Federation

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D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers

 Topics: D1 PS2 - Materials for Electrotechnical Technical Purposes and Modelling  
 Keywords: cellulose, insulation, degree of polymerization, supramolecular structure, grinding  

**The influence of Preparation Method of Cellulose Insulation Samples on Determining the Degree of Polymerization**

Leonid DARIAN¹, Victor GAVRILYUK²  
¹JSC «Technical Inspection UES», Russian Federation; ²MIREA — Russian Technological University, Russian Federation

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 Topics: D1 PS2 - Materials for Electrotechnical Technical Purposes and Modelling  
 Keywords: mineral oil, sediment, metals, colloids, paper isolation, spectral methods, organometallic compounds, salts of organic acids  

**On the Control and Mechanism of Formation of Organometallic Compounds in Service Oil**

Marina LYUTIKOVA¹, Sergey NEKHOROSHEV², Alexander KONOVALOV¹  
¹PJSC ROSSETI, Russian Federation; ²Kvanty-Mansiysk State Medical Academy, Russian Federation
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| Topics: D1 PS2 - Materials for Electrotechnical Technical Purposes and Modelling |
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| **Use of Finite Element Model for Simulation of Partial Discharge Detection Circuit in Contaminated Paper-Oil Insulation Systems** |
| Carlos Kleber DA COSTA ARRUDA¹, Adriana DE CASTRO PASSOS MARTINS², Alain François SANSON LEVY³, Orsino BORGES DE OLIVEIRA FILHO¹ |
| ¹Brazilian NC of CIGRE, Brazil; Eletrobras CEPEL; ²CEMIG; ³Consultant |

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| **Thermal class of thermally upgraded paper in natural ester and in mineral insulating oils according to IEEE C57.100-2011** |
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| ¹Brazilian NC of CIGRE, Brazil; Vegoor; ²Consultant |

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| **Thermal stresses of hybrid paper (aramid/cellulose) in natural ester and in mineral insulating oils** |
| Helena Maria WILHELM¹, Paulo FERNANDES¹, Richard MAREK², Marco MARIN³, Germano F. MORAES³, Nelson VELOSO³, Tiago MARCHESAN³, Vitor BENDER³ |
| ¹Brazilian NC of CIGRE, Brazil; Vegoor; ²Consultant; ³COPEL; ⁴UFSM University |

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| **Silver Corrosion Testing and Mitigation** |
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| ¹Electrical Engineering Institute Nikola Tesla, Serbia; ²Faculty of Technology and Metallurgy of the University of Belgrade, Serbia |

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| Pär WEDIN |
| Nynas AB, Sweden |

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| Kenji OKAMOTO¹, Naoki HAYAKAWA², Katsumi KATO³, Naoki OSAWA¹, Masahiro KOZAKO³, Hitoshi OKUBO³ |
| ¹Fuji Electric Co., Ltd., Japan; ²Nagoya University, Japan; ³N. I. T., Nihama College, Japan; ⁴Kanazawa Institute of Technology, Japan; ⁵Kyushu Institute of Technology, Japan; ⁶Aichi Institute of Technology, Japan |

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| Rouven BERKEMEIER¹, Robert BACH¹, Niklas PECK¹, Stefan TENBOHLEN² |
| ¹South Westphalia University of Applied Sciences Soest, Germany; ²Universität Stuttgart, Germany |
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M-Ramez HALLOUM, Subba REDDY B*
Indian Institute of Science, India

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Taeuk KIM, Jonghae KIM, Youngjae CHOI, Youngseng KIM
LS Cable & System, Korea, Republic of (South Korea)

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Mikael UNGE
NKT AB, Sweden

Analysis of the application of flexible graphene grounding material in photovoltaic power plants under harsh geological conditions

Xiaobing YU1, Songsong WU1, Zhenpeng FAN1, Chengfang ZHOU1, Yue HUANG1, Xingguo LIU1, Tao DING1, Hui XU1, Jie WANG2, Yang NIE1, Jian GUO1, Yang DONG1
1Huaneng Hubei New Energy Co., Ltd, China; 2Central Southern China Electric Power Design Institute Co., Ltd. Of Cpecc China

Innovative use case of recycled oil in a 57 MVA transformer at EDF SEI-Corse

Christophe ELLEAU
EDF

Chemistry of C4-FN gas mixtures and application in high-voltage equipment

Marcel STOECKLI1, Lise DONZEL2*, Saskia BUFFONI2, Pawel KRAWczyk2, Michael GATZSCH62
1Electrosuisse, Switzerland - CIGRE NC Secretariat; 2Hitachi Energy, Switzerland

Environmentally friendly and highly efficient novel corrosion protection coatings for electrical equipment under harsh environmental conditions

Ivanka HOEHLIN1, Jürgen BÜTTNER1, Valentin KOPP1, Christian SCHRAMB1
1Chemische Industrie Erlangen, Germany; 2Siemens Energy, Germany
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Topics: D1 PS3 - Materials to enable the Energy Transition
Keywords: Rechargeable battery cells, lithium ion battery (LiB), All-solid-state battery (ASSB), Dielectric capacitors

Recent development of nanomaterials for batteries and dielectric capacitors for energy storage in Japan
Yasunori TANAKA¹, Makoto KAMBARA², Minoru OSADA³, Shigemitsu OKABE⁴, Akiko KUMADA⁵
¹Kanazawa University, Japan; ²Osaka University, Japan; ³Nagoya University, Japan; ⁴The University of Tokyo, Japan

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D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers
Topics: D1 PS3 - Materials to enable the Energy Transition
Keywords: SF6 Alternative, Eco-friendly, Dielectric Breakdown Strength, Machine Learning, Quantum Mechanics

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Masahiro SATO, Hajime SHIMAKAWA, Akiko KUMADA
The University of Tokyo, Japan

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Topics: D1 PS3 - Materials to enable the Energy Transition
Keywords: Biodegradable, dielectric response, FDS, Kraft paper, mineral oil, moisture, PDC, vegetable oil

New C4-FN and C4-FN mixture gas models as a common reference for users and equipment manufacturers
Christian IHMELS¹, Max CLAESSENS², Michael GATZSCHE³, Maxime PERRET⁴, Thomas BERTELOOT⁵, Christophe COQUELET⁶
¹LTP GmbH, Germany; ²Hitachi Energy, Switzerland; ³GE Vernova, Switzerland; ⁴GE Vernova, France; ⁵IMT Mines Albi, France

ID: 11861
D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers
Topics: D1 PS3 - Materials to enable the Energy Transition
Keywords: Biodegradable, dielectric response, FDS, Kraft paper, mineral oil, moisture, PDC, vegetable oil

Experimental evaluation of the dielectric properties of insulating paper impregnated in mineral and vegetable oil as a function of moisture
Ismael ANTOLIN, Pedro J. QUINTANILLA, Cristina MENDEZ, Cristian OLMO, Pablo GOMEZ
Departamento de Ingeniería Eléctrica y Energética, Universidad de Cantabria Santander, Spain

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D1 MATERIALS AND EMERGING TEST TECHNIQUES - Full Papers
Topics: D1 PS3 - Materials to enable the Energy Transition
Keywords: Renewable energy project development, PV solar cells, Perovskite solar cells, Energy transition

Introducing Perovskite Solar Cells into Renewable Energy Project Development
Mokgadi MALEFAFANA
Sturdee Energy Southern Africa (Pty) Ltd, South Africa

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Exploration and Practice of Cloud Orchestration in New Power System Distribution Scenarios
Fuyou SUN¹, Xiaolong REM², Yunzhan ZAI¹, Shoubin ZAI¹, Wenbo XIA¹, Lianchang SONG¹
¹Huawei Technologies Co., Ltd., China; ²State Grid Corporation of China, China

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D2 INFORMATION SYSTEMS, TELECOMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: DoA estimation, Substation asset management, Switched beam antenna array, WSN

Design of smart planar antenna array with optimal directivity in eight directions detecting ISM band wireless sensors for IT/OT solutions and substation asset condition monitoring & deep learning applications
Reham Elsamnty EL SAMNTY¹, Sabah Mashaly MASHALY¹, Ahdab El Morshedh MORCHEDY²
¹Egyptian Electricity Transmission Company (EETC) Egypt; ²Egyptian National Committee of Cigre
A possible win-win cohabitation of open-source and standardization
Laurent GUISE1, Gilles NATIVEL2, Benoit JEANSON3, Philippe TAILHADES4, Boris DOLLEY5, Eric LAMBERT6, Camille BLOCH4
1Energeysemantic.com, France; 2ENEDIS, France; 3RTE, France; 4GIMELEC, France; 5EDF, France; 6Schneider Electric, France

OMEGA-X: Energy Data Space for improving efficiency of electric power systems leveraging semantic interoperability and AI
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1EDF R&D, France; 2Tecnalia, Spain; 3ATOS, Spain; 4Trialog, France; 5Pupin Institute, Serbia; 6Mines St Etienne, France

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Alessandro PEDRETTI
Hitachi Energy, Italy

Digital twin for asset management of electric power systems based on IEC CIM and BIM integration
Enea BIONDA
RSE, Italy

Market driven architecture for remote monitoring of HV assets
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HITACHI ENERGY, Italy

Orchestrated ICT architecture for grid monitoring of distribution power grid
Roberta TERRUGGIA
RSE, Italy

Development of Common Distribution Power System Model (CDPSM) based profiles and the proposed validation process
Harish KRISHNAPPA, Stephan LUPP, Bas KRUIMER, Lino PRKA
DNV

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Po-Chen CHE1, Reddy MANDATI1, Vladoslav ANDERSON1, Ankush AGARWAL1, David BARNARD2, Michael FINN2, Jesse CROMER2, Tatjana DOKIC1, Andrew MCCUALEY2, Clay TUTAJ2, Neha DAVE3, Bobby BESHARATI3, Jamie BARNETT4, Timothy KRALL1
1Exelon Corporation, United States of America; 2BGE, An Exelon Company, United States of America
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<tr>
<td>A.I. Searchable Synchronphasor Database for Power System Protection</td>
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<td>Alberto RAMIREZ ORQUIN, Vanessa RAMIREZ</td>
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<td>Resilient Grids LLC, United States of America</td>
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<td>AI and Cloud-based Digital Transformation of Utility Asset Management and Inspections</td>
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<td>Junhui ZHAO, Jing YANG, Umair ZIA, Asim FAZLAGIC</td>
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<td>Keywords: Digitalization of distribution assets by use of DSO-API-REST</td>
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<td>Markel SANZ HERAS1, David SANTACRUZ PELAEZ1, Fernando IBÁÑEZ ALAMEDA2, Jonathan GONZÁLEZ RÍOS3</td>
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<td>1I-DE, Spain; 2Tecnalia, Spain; 3Merytronic, Spain</td>
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<td>Yundong SEO1, Seungho HWANG1, Gilsung BYEON2, Dongjun WON3</td>
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<td>1SK Telecom Co., Ltd.; 2Korea Electrotechnology Research Institute, Korea, Republic of (South Korea); 3Inha University, Korea, Republic of (South Korea)</td>
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<td>Andrey RODIONOV1, Kirill BUTIN2, Aleksandr POPOV1, Dmitriy DUBININ2, Olga ZHURAVLEVA3</td>
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D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: AI, ADMS, Big Data, decision support system, distribution networks, neural networks, state estimation, power flow forecasting

**Symbiosis of Artificial Intelligences in Automated Systems of Supervisory Control of the Electrical Grid of a Distribution Grid Company**

Sergey RYKOVANOV, Mikhail KHOZYAINOV
SYSTEL LLC, Russian Federation

ID: 10858
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: Technology; Virtual reality; Power Transmission, Distribution and Generation

**Virtual Reality and gamification as tools for training operation teams, maintenance of substations and energy transmission lines**

Leandro Henrique DA SILVA¹, Juliano CORTES DE SOUZA², Josias MATOS DE ARAUJO³
¹Brazilian NC of CIGRE, Brazil; Virtual Engenharia; ²Comando Engenharia; ³Eng Smart Lead

ID: 10859
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: Utility Communications, Substation IED Management, Telecom Management

**Advanced Management and Control of Grid Substation’s IEDs and Communication Devices in the Electric Power Utility**

Marcelo ZAPELLA, Ramesh POTLAPULA, Adriano PIRES, Mehrdad MESBAH
Brazilian NC of CIGRE, Brazil; GE Grid Solutions

ID: 10860
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: WAMPAC, 5G, IEC 61850, Power System


Mayara Helena SANTOS¹, Nicolas FULLI¹, Fabio BRUNS², Ana Carolina PEDREIRA CAPELLA³, Joyce MEIRELLES³, Yona LOPES²
¹Brazilian NC of CIGRE, Brazil; UFF Fluminense Federal University; YSMART ECT; ²UFF Fluminense Federal University; ³TIM Brasil

ID: 11009
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: Hyperparameter tuning, Key Performance Indicators estimation, Machine Learning Regression algorithm, Management decision-making support, Multi-step annual Failure Forecasting, Remote Terminal Unit analog modules

**Leveraging Machine Learning for Multi-Step Failure Forecasting in RTU Analog Modules and Estimating Key Performance Indicators to Support Management Decision-Making**

Daniel FELIP, Eduardo CORONEL
Itaipu Binacional

ID: 11045
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems

**Probabilistic framework for resilience enhancement of distribution grids**

Ashwin SHIRSAT², Jishnudeep KAR², Kevin SCHOENLEBER¹, Milos SUBASIC¹, Katarina KNEZOVIC¹, Dmitry SHCHETININ², Lena SEMBACH¹, Elise FAHY¹, Henrie NEL⁴
¹Hitachi Energy Research, Germany; ²Hitachi Energy Research, USA; ³Hitachi Energy Research Switzerland; ⁴Hitachi Energy South Africa

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D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems

**Optical Fiber Monitoring and Management System (ONMS)**

Ariel CAMPOS
TRANSENER
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<td>Amba Prasad TIWARI, Royal SUTNGA, Abrar AHMAD, Paominlal DOUNGEL, Sakal DEEP*</td>
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Grafana for Grid data Monitoring and Visualization at Western Regional Load Despatch Centre (WRLDC), GRID-INDIA
Pulla Naga SUDHIR*, Mahesh M MEHANDALE, Veluri BALAJI, Sunil K PATIL
Grid Controller Of India Limited, India

Energy Optimization in Blockchain Enabled Smart Distribution Grid
Shyam AGARWAL, Amit JAIN*
Central Power Research Institute, India

State-of-the-Art Algorithms for short-term residential Load forecasting for Smart Grids
Vasileios LAITSOS1, Georgios VONTZOS2, Georgios LOUKOS1, Paschalis PARASCHOUDIS1, Konstantinos KAOUSIAS1, Katerina DRIVAKOU1, Despoina MAKRYGIORGOU2, Dimitrios BARGIOTAS2
1Hellenic Electricity Distribution Network Operator, Greece; 2Univ. of Thessaly - Dept. of Elec. and Comp. Eng., Greece; 3UBITECH ENERGY, Belgium; *Independent Power Transmission Operator, Greece

Enhancing Power Grid Failure Data by Leveraging AI-driven Text Classification: A Danish Case Study
Konrad SUNDSGAARD
Green Power Denmark

Analyses of Lightning Induced Faults Recorded by Diverse Monitoring Systems in the Transmission Network Based on a New Concept of Data Lake Design
Bozidar FILIPOVIC-GRCIC1, Bojan FRANC1, Bruno JURISIC2, Tihomir JAKOVIC3, Tomislav ZUPAN4, Antonija IVISIC1, Ivan STURLIC4, Alan ZUPAN3
1University of Zagreb Faculty of Electrical Engineering and Computing, Zagreb, Croatia; 2Končar – Electrical Engineering Institute Ltd., Croatia; 3Business Analytics and BI, Comping d.o.o., Croatia; 4Croatian Transmission System Operator Plc., Croatia

IT/OT Convergence and Standard Architectures for DERs Considering Companion Specifications, Interoperability, IoT Technologies and Cloud Solutions
Luis BERRIO, Daniel URQUINA, Rafael LUNA, Fabio GIRALDO, Melqui CAMACHO, Omar ALZATE, Marcela GIRALDO
EPM

Driving and Empowering Digital Transformation: Successful Implementation of IIoT Pilots for Advanced Monitoring
Mauricio HERNANDEZ, German CARDENAS
ISA Intercolombia
ID: 11812
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS1 - IT/OT Solutions to improve the Efficiency and Resilience of Electric Power Systems
Keywords: Artificial Intelligence, Automatic control system, Biogas power plant, Load forecasting, Peak demand reduction

**Artificial Neural Network-Based Peak Demand Forecasting and Biogas Power Plant Control for Peak Demand Reduction in Factory**
Praditthon PATCHARAUBONGASEAM, Supatchaya LEELUDEJ
Electricity Generating Authority of Thailand (EGAT), Thailand

**PS2 - CYBERSECURITY IN EMERGING APPLICATION DOMAINS AND TECHNOLOGIES FOR SECURING ENERGY ORGANISATIONS**

ID: 10401
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS2 - Cybersecurity in Emerging Application Domains and Technologies for Securing Energy Organisations

**Cybersecurity In the Loop for multi energy infrastructures**
Giovanna DONDOSSOLA
RSE, Italy

ID: 10656
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS2 - Cybersecurity in Emerging Application Domains and Technologies for Securing Energy Organisations
Keywords: Cybersecurity, Operation Technology, OT Device-management, Data-management, Attribute-based-access-control, Privileged-access-management-(PAM)

**The Elektrilevi’s Advanced Remote Engineering Platform**
Indrek KÜNNAPUU1, Hando LUUS2, Rene VOOG1, Ameen HAMDON2
1Elektrilevi OÜ, Estonia; 2Eesti Energia AS, Estonia; 3SUBNET Solutions Inc., Canada

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D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS2 - Cybersecurity in Emerging Application Domains and Technologies for Securing Energy Organisations
Keywords: EV risks, risk, cybersecurity, threats, attacks, risk mitigation, security controls

**Performing Risk Assessments of EV Charging Systems**
Djenana CAMPARA1, Nikolai MANSOUROVI1, Adnan BOSOVICI2, Svetlana MISUT2, Adnan AHMETHDZIC2, Meludin VELEDAR1
1BH K CIGRE, Bosnia and Herzegovina; 2KDM Analytics, Canada; 3Elektroprivreda BiH, Bosna i i Herzegovina

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D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS2 - Cybersecurity in Emerging Application Domains and Technologies for Securing Energy Organisations

**Lessons Learned from Infrastructure Attacks on Substations A Lens on North and South America.**
Pablo NARVAEZ1, Etilk CANTR2
1UMS Group; 2ISA Intercolombia

ID: 11205
D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS2 - Cybersecurity in Emerging Application Domains and Technologies for Securing Energy Organisations

**A Strategy for Cyber Risk Mitigation in Smart Grids Through Traffic Management**
Oscar TOBAR1, German RUEDA1, Johan CASTRO1, Octavio DIAZ1, German ZAPATA1, Rodolfo GARCÍA2
1Universidad Nacional; 2Enel Colombia

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D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS2 - Cybersecurity in Emerging Application Domains and Technologies for Securing Energy Organisations

**Cybersecurity for Communication Systems for Digital Electrical Substations Leveraging Emerging Network Technologies**
German RUEDA1, Oscar TOBAR1, John BRANCH1, Juan BOTERO2, Sergio GUTIERREZ2, Germán ZAPATA1
1Universidad Nacional; 2Universidad de Antioquia
Implementing a Protection Management System in AWS Cloud: Strict Cyber Security Standards & Rules and experience of system in Production
Sanitos GARCIA ZAMORA¹, Pavel IPENZA², Ameen HAMDON³
¹ENEL Distribution Peru; ²Nakama S.A.C Peru; ³SUBNET SOLUTIONS INC

N.M. SHETH*, B.J. PATEL, D.P. SINGH
Gujarat Energy Transmission Co. Ltd, India

Cyber Security Assessment of Digital Substation using Petri Nets
Sajal SARKAR*, Yogendra TIWARI, Anand SHANKAR
Power Grid Corporation of India Ltd, India

Hardened (Air-gapped) IT-OT Interconnection – A Case study on Proof of Concept in Context of Power System Operation
K MURALIKRISHNA, Harish RATHOUR, Ankur GULATI, Anwaya Bilas SENGUPTA*
GRID-INDIA, India

Evaluation of the Maturity of Cybersecurity in the Colombian Power System
Jaime ZAPATA¹, Juan MOLINA², Luisa BUITRAGO²
¹XM; ²Colombia Inteligente

Analysis of High-Impact Scenarios for Cybersecurity in the Colombian Power System
Diego ZULUAGA¹, Rubén VILLA², Juan MOLINA³, Ángelo SALAZAR⁴, Pedro CADENA⁵, Juan VICTORIA⁶, Fabio MENDOZA⁷, Manuel SANTANDER⁷
¹CrossDMZ; ²Independiente; ³Colombia Inteligente; ⁴Universidad del Valle; ⁵Escuela Superior de Guerra; ⁶Termocandelaria; ⁷Kontinua Group

Enhancing Cybersecurity in Critical Infrastructure: Leveraging Next Generation Firewalls (NGFW) for Robust Protection in OT and Substation Environments
Kgomotso MANYAPETSA
Cigre Southern Africa, South Africa
| ID: 10101 | D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers | Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks
Keywords: 5G, 5G Standalone, Protection, Fault, Fault Indication, Edge Computing |
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<td>Exploring the Reliability of Commercial 5G Standalone Networks for Virtual Fault Passage Indication</td>
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<td>Petra RAUSSI1, Heli KOKKONIEMI-TARKKANEN1, Jorma KILPI1, Anna KULMALA2, Petri HOVILA2</td>
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| ID: 10109 | D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers | Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks
Keywords: 5G, Edge computing, Fault, Line differential, Protection |
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<td>Applicability of 5G Communication to Line Differential Protection for Distribution Networks</td>
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<td>Petri HOVILA, Petri SYVÄLUOMA, Anna KULMALA, Rajasekara DEVADASS, Petteri VAARA</td>
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| ID: 10110 | D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers | Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks
Keywords: MPLS-TP, teleprotection, PTP, inter substation communications |
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<td>Migration from TDM Networks to MPLS-TP, Field Experiences</td>
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Keywords: MPLS-TP, SDH, Line Differential Protection, Teleprotection |
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<td>Optical Systems Performance for Line Protection Schemes</td>
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| ID: 10571 | D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers | Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks
Keywords: Utility Infrastructure, Network Telecommunication, Radio Frequency, Smart Metering, Smart City |
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<td>The Next Generation of Joint-Use Utility Infrastructure</td>
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<td>Mahavish MAHMOOD, Marianne GUIEB, Gregory R. BELL</td>
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| ID: 10572 | D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers | Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks
Keywords: Passive Optical Network (PON); Gigabyte Passive Optical Network (GPON); Expedited, Deterministic, Redundant, PON (EDRP); Optical Line Terminal (OLT); Optical Network Terminal (ONT) |
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<td>Redundant Passive Optical Network (PON) Transport for Grid Intelligence</td>
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<td>Juan ORNELAS1, Michael MORGAN1, Arien MAJETTE1, James CONWAY2</td>
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| ID: 10573 | D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers | Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks
Keywords: Evolved Packet Core (EPC), Private Long-Term Evolution (PLTE), Radio Access Network (RAN), User Equipment (UE) |
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<td>PLTE Testing of Utility Use Cases in Support of Grid Modernization</td>
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<td>Jayson SHIAU1, Arien MAJETTE2, Nwabueze PHIL-EBOSIE1, Michael MORGAN2</td>
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D2 INFORMATION SYSTEMS, TELECOMMUNICATIONS AND CYBERSECURITY - Full Papers
Topics: D2 PS3 - Meeting the Challenges of Energy Transition with Reliable, Scalable, and Efficient Telecommunications Networks

**Migration from MPLS-TP & SDH Hybrid Networks to OTN Optical Transport Networks**
Ariel CAMPOS
TRANSENER

**Mapping Multiprotocol Services into a MPLS Critical Infrastructure Network**
Juan Ramón FEIJOO MARTÍNEZ, José María DELGADO ÁLVAREZ, Bruno PERALTA VICENTE
Red Eléctrica, Spain

**Quantum Key Distribution for MPLS-TP Traffic Encryption**
Marcel STOECKLI1, Ramon BAECHLI*2, Rouven FLOETER2, Vivek PALANGADAN2, Axel FOERY3
1ELECTROSUISSE, Switzerland - CIGRE NC Secretariat; 2Hitachi Energy, Switzerland; 3ID Quantique, Switzerland

**Electric Power Industry of Serbia IP MPLS network application for communications of technical information systems**
Danilo LALOVIĆ1, Vesna VUKIČEVIĆ1, Ivan VUKADINOVIĆ1, Vigor STANIŠIĆ1, Zlatko MITROVIĆ1, Miodrag JEVTIĆ2
1EPS JSC, Serbia; 2SAGA, Serbia

**Implementation of “Software-Defined Networking” as an Alternative for Efficient Traffic Management in Digital Substations**
Octavio DIAZ1, Germán RUEDA1, Johan CASTRO1, Oscar TOBAR1, Germán ZAPATA1, Rodolfo GARCIA2
1Universidad Nacional; 2Enel Colombia

**IP Network Availability Improvement Initiatives**
Sho TAMURA, Yuichi SHINOHARA
TEPCO Power Grid, Inc., Japan

**Techniques and methods in building resilient networks that support critical applications for Electricity Power Utilities**
Ryutaro MURAKAMI1, Makoto KUBO1, Hiroyuki NAKAGAWA2
1Tohoku Electric Power Network Co., Inc., Japan; 2Nakagawa Juniper Networks, Inc., Japan

**Requirements for resilient packet-switched network using MPLS-TP and wireless microwave technology**
Toshiki KINOSHITA1, Davy HAEGDORENS2
1Chugoku Electric Power Transmission & Distribution Co., Inc., Japan; 2OTN Systems, Belgium
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<td>Dr. Sunita CHOHAN*, Shyama KUMARI, Gaurav AWAL, Sangita Sarkar SARKAR, Nutan Mishra MISHRA, VS Bhal BHAL</td>
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<td>Chrystian RUIZ DIAZ1, Enrique DAVALOS3, Cecilia VEGA1</td>
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