2023 13th International Conference on Power and Energy Systems (ICPES 2023)

Chengdu, China
8-10 December 2023

IEEE Catalog Number: CFP23N69-POD
ISBN: 979-8-3503-4507-0

Copyright © 2023 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP23N69-POD
ISBN (Print-On-Demand):	979-8-3503-4507-0
ISBN (Online):	979-8-3503-4506-3
ISSN:	2767-7303

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

2023 13th International Conference on Power and Energy Systems

(ICPES 2023)

Table of Contents

Preface ..... **xii**
Committees ..... **xiii**

✧ **High Voltage Direct Current Transmission and Distribution System**

Multi-terminal DC Transmission System and the Control Strategy for Ecological Restoration in the Mining Area 1
Rende Dai, Yingrui Liu, Zhiyong Li, Yuan Cao

Bi-level Optimization of Energy Management for Agro Food Park in Distribution Market 7
Keyin Jia, Chenggang Hao, Yunliang Song, Le Yang, Cong Liu, Yaocheng Jia, Junyan Shao

Evolution of Arc Model and Its Application in Low-Voltage Single-Phase Grounding Fault 13
Changan Ji, Qixu Chen, Qian Zhang, Qunjing Wang, Lufeng Ju, Quan Chen

Development of a Novel Extendable Damped AC Testing System 19
Qian Li, Qichao Li, Kai Yi, Bin Chang, Li Wang, Lei Jin

Research on Influence of Voltage and Temperature on Frequency Domain Dielectric Spectrum of Drytype Epoxy Resin Impregnated Paper Insulating Bushings 24
Zhicheng Pan, Jun Deng, Jinyin Zhang, Zhicheng Xie, Haibing Zhou, Heng Wu

Research on Optimization Strategy of Extinguishing Angle Control Function in DC Transmission 30
Haibin Liu, Weipeng Liu, Yawei Chang, Ke Zhang

Comparison and Description of Enhanced Department-Based Arc Flash Safety Assessment with Substation-Based Arc Flash Safety Assessment for the Improvement of Work Place Safety 35
Md Abid Khan, Rashid Almisfer, Fareed Alsulami, Mohammed Alghazi, Ali Alalharith

Low Harmonic 12-Pulse Thyristor-Based Rectifier with an Auxiliary Circuit 40
Xu Weidong, Zhang Damin, Zhang Baosen, Li Yonghu, Ding Zexiang, Zhong Yichuan

Insulation Defect Lifecycle Prediction of Switchgear Based on Multi-Parameter MKL Model 45
Nan He, Hongjing Liu, Kewen Liu, Hongliang Liu, Wang Miao, Baoqin Cao, Huiling Dou

A Self Blocking Hybrid Submodule with Capacitor Voltage Self-Balancing Capability.....51
Yu Zhao, Xin Liu, Kuan Zheng, Jianpo Zhang

Comprehensive Configuration Method for Static and Dynamic Reactive Power Compensation of Multi-Voltage Level Urban Power Grid.....57
Yunting Song, Jiming Gu, Zhenghai Yuan, Xinyu Liu, Shaoxuan Zhu, Gaofeng Yang, Tao Chen, Jialin Chen

Security Evaluation of Voltage Controlled Active Distribution Network at Point of Common Coupling.....64
Zehuai Liu, Xuefeng Ning, Zhenglu Shi

Research on Arc Model Based on Dielectric Adaptive Parameters for High Resistance Grounding Faults in Medium Voltage Distribution Network.....70
Qingwei Wei, Yifeng Cheng, Jun Tan, Wei Li, LuFeng Ju, Rui Zhang

Voltage Stability Improvement Method of Multi-port Energy System Based on Impedance Remodeling.....76
Zhiliang Wang, Meng Wang, Hongxu Liu, Xiaodong Fan, Yizhou Ye, Haoyu Li

✧ Control Models, Parameter Optimization, and Reliability Evaluation in Power Systems

Impact of SNR on Sensorless Control of PMSMs with PHF Signal Injection.....82
Gayani De Soysa, Udaya Madawala, Matheus Bevilaqua, Nitish Patel

Simulation and Analysis of Monitoring Signals of Thyristor Level Control Unit Considering Parameters Deterioration of Converter Valve.....88
Longchen Liu, Zhijie Jia, Lei Pang, Peng Zhang, Shixiong Tang, Yu Huang

Optimal Control of Wave Energy Conversion Supplemented by the Adaptive Compensation.....95
Huijin Lin, Weihong Kuang, Junhua Yang, Jinchuan Guo, Xinmei Gu, Yu Zhou, Xin He, LiTao Huang, Ni liu

A Novel Low Power Network Topology for Virtual Power Plants.....101
Wuzhou Nie, Liming Chen, Yong Chen, Yuhao Wang, Lei Ning

Power Source Planning Considering Unit Inertia Level under the Retirement of Thermal Power Units.....106
Nan Yang, Chao Sun, Zheng Wang, Shanke Mou, Lu Liu, Haozhong Cheng

✧ Safe Operation and Reliability Analysis in Distribution Networks

Research on Fault Section Location Method of Distribution Network Based on Waveform Similarity.....112
Xuhui Hu

Research Influence of Distributed Photovoltaic Connected to Distribution Network on Its Loss and Voltage.....118
Chen Liu, Chunmin Li, Weimin Chen, Jiaju Wang, Tai Bai, Li Zhong, Jianquan Fang

Analysis the Impact of Electric Vehicles Integrated to the Distribution Network on Its Line Loss and Voltage.....124
Jianquan Fang, Lisi Xue, Li Zhong, Junsheng Zhang, Zhi Xie, Chunmin Li

An Automated Parameter Design Framework for Flexible Interconnection Devices in Distribution Networks.....129
Liqiang Yuan, Jingfeng Wang, Minghao Zheng, Kainan Chen, Chao Sheng, Zhengming Zhao

The Active and Reactive Power Coordinated Operation Strategies of Distribution Network with High Proportion of Photovoltaic 135

Yuanyuan Wang, Di Ge, Zhifei Cai, Junfeng Qu, Guodong Wang, Haiyang Li, Yabin Hu

Self-healing Recovery of Distribution Network Based on Weakness Identification 141

Dan Liu, Ping Xiong

Research on Hierarchical Coordinated Control Strategy for Power Quality in Active Distribution Network 148

Honglei Xu, Jinggeng Gao, Hu Li, Shibin Chen

Improved Topology Identification Method for Low-voltage Distribution Networks by Combining Quadratic Programming and Clustering 155

Haimin Hong, Fei Jin, Zhenjiang Pang, Zhaowu Zhan, Minglang Wu, Yuanyang Tang, Jinyu Zhao, Xiaodong Pan

Research on Distribution Network Multidimensional Resilience Evaluation Methods 161

Hui Wang, Yu Bai, Huan Yan, Yudi Ding, Zhenghua Guo

✧ **Power Equipment Status Monitoring and Protection**

Research and Application of Convolutional Network Voice Based on Substation Inspection Scenario 168

Yao Qiang, Luan Yibin, Shen Meiqin, Zou Xiaoyan, Deng Zilong

Experimental Saliency Modeling of Synchronous Reluctance Motor with Four-Vector Injection 174

Bencheng Zhong, Jianyong Su, Guijie Yang, Kaiwen Tan, He Li

Simulation Study on Electrical Life Breaking Capacity of 550kV SF6 Circuit Breaker 180

Yunlei Song, Zhijun Wang, Hao Zhang, Miaoxin Li, Yapei Liu, Yongqi Yao

A Method to Evaluate the Safety Margin for Setting Value of the Transformer Protection Device with Domestic Chips and Analyze the Influencing Factors 185

Huinan Shen, Xin Qie, Hongming Shen, Ying Liu, Haiyan Hong, Ancheng Xue

Study on the Effect of Absorbing Moisture of Anhydride Curing Agent on the Dielectric Properties of Epoxy Resin Insulation Materials 190

Yuchen Liu, Yushun Zhao, Chong Zhang, Huize Cui, Ruilu Guo, Shuo Chen, Ying Wei, Feiyue Ma

Nonlinear E-field Simulation of HVDC Converter Transformer Busing and Its Structure Optimization with RBF Neural Network and NSGA-II Algorithm 195

Yongsheng He, Shiling Zhang, Zongxiang Lu, Pengbo Wang

Mathematical Model for High Precision Detection and Flow Evaluation of SF6 Gas Decomposition Products under Lightning Impulse 200

Zhang Shiling, Xiang Bin, Deng Baojia, Dai Liangjun

A STDAB-DETR Model for Secure Detection of Electrical Construction Sites 207

Jing Ma, Laijun Chen, Bowen Ren, Suxun Zhu

✧ Collaborative Control and Capacity Allocation in Power Systems

Research on Capacity Configuration Optimization of Multi-Energy Complementary System Using Deep Reinforce Learning 213

Zhuang Tang, Bo Chai, Jie Li, Yishen Wang, Siyan Liu, Xinghua Shi

Characteristic Analysis of New Adjustable Power Module for ECRH on EAST 219

Lei Xiong, Zhang Jian, Guan Kaining, Liu Qinghong, Huang Yiyun, Fan Wendi

Sliding-mode Model Predictive Control for PMSMs with Current Compensation 225

Peng Li, Sai Zhang, Anwen Shen, Qipeng Tang

Optimization of High Voltage and Large Capacity Circuit Breakers Based on Parallel Flow Field Calculation 230

Hao Zhang, Zhijun Wang, Yunlei Song, Miaoxin Li, Yapei Liu, Yongqi Yao

Probabilistic Optimal Power Flow Calculation Method of AC-DC Hybrid Distribution Network with New Energy and Electric Vehicle 235

Ming Lu, Huichang Yao, Xiaoyang Tong, Xing Liu

Research on Influence and Capacity Configuration Optimization Method of Energy Storage on Power Angle Stability of Large Power Grids 240

Junling Wu, Jian Zhang, Qian Dai, Lei Yun

✧ Electrical Equipment Operation Safety and Heat Generation Analysis

Robotic Arm and Its Control System for Replacing Bushing of Converter Transformers 246

Haibin Zhou, Zhicheng Xie, Zhicheng Pan, Jun Deng

A Ultrasonic Localization Technology for Partial Discharge Based on Beamforming Algorithm 251

Yanan Wang, Yuxiao Zhou, Lina Geng

Thermodynamic Property Improvement of Silicone Rubber for Traction Transformer Based on Molecular Simulation 256

Sixiang Chen, Zilan He, Woyang Li

Temperature Rise and Ampacity Analysis of Buried Power Cable Cores Based on Electric-magnetic thermal-moisture Transfer Coupling Calculation 261

Heqi Jiang, Xiaoyi Zhao, Yongchun Liang, Chenzhao Fu

Study of Natural Convection Heat Transfer Characteristics and Correlation Equation on the Outer Surface of Power Transformer Bushings 266

Bangfa Chen, Jing Huang, Yingyi Xia

Optimization Strategy of Energy Station with Thermal Storage by Heat Pump in Photovoltaic Building 271

Junxia Meng, Hongyin Chen, Hanjun Deng, Minqi Yu, Shuai Yang, Ximing Wan

Modified Solar-Powered Multi-generation System Integrated with ORC, HDH, and DCS with New a Heat Recovery System 278

Ahmed Al-Zahrani

Efficient Reduced-Order Algorithm for Transient Simulation of Transformer Thermal Characteristics 288

Meng Gao, Ran Zhuo, Sicheng Zhao, Qiulin Chen, Mingli Fu, Lei Jia, Guoli Wang

Research on Intelligent Inspection Method of Multi-robot Joint Inspection of Power Equipment under New Energy Access 295

Guoliang Qian, Jiahui Zhang, Zilong Deng, Qinbin Huang, Leijian Hu

✧ Wind Farm Simulation and Transmission Capacity Simulation Analysis

Parameter Identification of Frequency Control Model for Wind Farm Field Based on Forgetting Factor Least Squares 300

Yongjun Yu, Lichao Wang, Peng Wang, Chenxinwei Yuan, Tiancheng Liu, Haoran Zhao, Wei Fan, QianFeng Shang

Adaptive Robust Control Method of Battery Storage Systems for Power Oscillation Suppression of MMC-HVDC Offshore Wind Farms.....307

Miaosong Gu, Lei Huang, Ming Lv, Rong Bian, Guoqiang Li, Zekai Ma, Chaofeng Hong, Wenke Jiang, Xiao Qi

A Practical Method for Generating Day-Ahead Output Probabilistic Scenarios of Multiple Wind Farms Based on K-Shape Clustering 313

Lin Bo, Taishan Xu, Mengfu Tu, Jinjun Lu

Analysis of Factors Affecting Broadband Oscillations in Flexible Low-Frequency Transmission System for Offshore Wind Power Based on Multiple Linear Regression 321

Wentao Li, Zhengang Lu, Ying Chen, Yanhui Xu

Day-Ahead Electricity Market Transaction Optimization Considering Wind Power and Medium and Long-Term Contract Decomposition 327

RongJun Chen, Long Liu, Jing Wu, Guangying Wang, Keke Wang

Wind Power Forecasting Method Considering Temporal-Spatial Feature Mining and Error Correcting.....332

Kai Yuan, Yanhui Chen, Chongbo Sun, *Ruosong Hou, Yi Song, Jingxian Yan, Zhiwei Wan, Jiakun An*

✧ Power Load Control and Prediction Calculation

LADRC and (1+PDD) Approach for Load Frequency Control of Interconnected System Using GWO Algorithm..337

Samina Akhtar, Lei Qi, Jahanzeab Hussain

Dynamic Scheduling Algorithm of Multiple New Energy Complementary Power Load Data 342

Guoliang Qian, Zhengding Zhu, Xiaoyan Zou, Yunjie Cai, Siqiang Li, Leijian Hu

A Novel Industrial Load Disaggregation Model Based on CNN-LSTM Neural Network with Attention Mechanism and Genetic Algorithm 348

Liang Zhu, Meng Yu, Aichao Yang, Junjian Zhu, Pengfei Hao, He Wen

Power supply Optimization Method Based on Multivariate Load Peak-Valley Complementary Characteristics ...353

Yudi Ding, Yue Guo, Yu Bai, Yanru Liu

Transient Frequency Coordination Support Method Considering Multiple HVDC Power Modulations and Flexible Load Regulation.....361

Changyong Chen, Peng Liu, Yanfeng Gou, Yi Hu, Jinglin Luo

✧ **Digital Operation and Decision-Making of Modern Power Grids**

Research on Applications of Virtual Power Plants for Power Grid Peak-shaving Under Inertia Constraints.....367

Xinfan Jiang, Yonggang Liu, Jinbo Wu, Dijun Hu

Harmonic Stability Analysis of a System Integrated with Photovoltaic Power Generation and Energy Storage Based on Impedance Analysis Method.....373

Yuexi Yang, Zhenyu Du, Xiao Zhou, Ying Chen, Le Zheng, Yanhui Xu

Microgrid Energy Management Based on Sample-Efficient Reinforcement Learning 379

Wenjing Zhang, Zhuo Chen, Yuanjun Zuo, Yanbo Long, Hong Qiao, Xianyong Xu

Adaptability Evaluation for LCC-HVDC Startup in Various Stages of Power Grid Black Start and Its Recommended Startup Strategy.....385

Ding Jian, Paulo Esmeraldo, Pedro Lima, Zhou Jing, Wang Yusheng, Zhang Shen

Research and Design of Power Information Engineering Supervision 392

Limei Zhang, Yiping Han, Ziwei Hong, Zhendong Zhao, Hongli Su, Haiyang Liu

Research on The Optimization Reserve Capacity of Integrated Source Grid Load Storage System Based on Chance Constrained Planning 397

Xiong Li, Weijing Zhao, Yunhui Chen, Yixiao Wang

Research on An Active Zoning Strategy of Regional Grid under Power Grid Attacks.....403

Rongzhao Yang, Yinsheng Su, Chao Fu, Yuxiang Xie, Junjie Li, Zexiang Zhu, Yuming Liu

✧ **Operation and Optimized Scheduling of New Energy Power Systems**

Day-ahead Scheduling Method Considering Uncertainty of Renewable Energy and Power System Operation Risk 408

Mengfu Tu, Taishan Xu, Lin Bo, Jinjun Lu

Study on the Model and Control Technology Requirements of Condenser with Flywheel Energy Storage for Transient Energy Balance 414

Xiaoguang Ma, Dahai Yu, Dongping Ai, Chengxiang Huo

Control Strategy for Power Quality Governance Based on Remaining Capacity of Grid Connected Photovoltaic Inverters.....419

Junxia Meng, Shuangyin Dai, Qionglin Li, Songcen Wang

Energy System Modeling of Liquid Cooled Propulsion Permanent Magnet Synchronous Motor for Electric Vehicles 424

Zichao Zhang, Qiang Song, Bilal Ahmed

Analysis of the Impact of Elastic Gas Storage Volume on the Distributed Compressed Air Energy Storage Systems 430

Ma Wei, Xie Yuguang, Li Jinzhong, Chen Renfeng, Zhang Hong, Liu Manjun, *Tan Wei*

A Hierarchical Framework for Vehicle-to-Grid (V2G) Distributed Control Combining Peer-to-peer Blockchain with Systemic Scheduling 436

Yifan Wei, Yimin Zhu, Yudi Qin, Yalun Li, Hewu Wang, Xuebing Han, Languang Lu, Minggao Ouyang

Research on Online Monitoring and Evaluation and Cluster Closed-Loop Control Technology for New Energy Sites 442

Wang Wei, Wu Di, Wu kechen, Lv Xiaofei, Gu Ming, Sun Guoming

A Spatial-temporal Neural Network for Photovoltaic Power Prediction 448

Yan Huang, Junwei Cao, Shixia Cai

✧ **New Integrated Energy Systems and Energy Storage Technologies**

Enhancing Power Quality in Grid Integration of Wind Energy System Using UPFC-BESS.....453

Jawad Hussain, Qi Huang, Jian Li, Fazal Hussain, Kashif Manzoor, Syed Adrees Ahmed

Harmonic Analysis and Suppression Strategy Analysis of Gigawatt-level-Scale Electrochemical Energy Storage Power Station 459

Xinmei Gu, Weihong Kuang, Huijin Lin, Jinchuan Guo, Yu Zhou, Chao He, Hongyuan Yuan, Ni liu

Research on Energy Storage Planning and Configuration Based on Spectrum Analysis 466

Xuan Yang, Zhiyuan Chen, Zixun Zheng, Lu Gao, Jiayi Shang, Xi Chen

A Smart Home Based on Renewable Energy with Net-Metering and Energy Storage Technology.....471

Fazal Hussain, Qi Huang, Jawad Hussain, Baqir Ali Mirjat, Kashif Manzoor, Syed Adrees Ahmed

SOC Estimation for Reconfigurable Lithium Battery Energy Storage System Based on Extended Kalman Filter 477

Shengkun Ma, Manshang Wang, Libo Jiang, Xiaoxi Liu, Tianwen Zhen

Optimal Joint Capacity Planning for Electricity Storage and Water Storage.....484

Yiming Yao, Chunyan Li, Bo Hu, Changzheng Shao

Study on Localized Substitution of Alkylbenzene Insulating Oil 490

Zhifeng Liu, Jianping Liao, Xiang Peng, Mingchun Hou, Fan Gao, Yufei Chen, Yongye Xu, Huaqiang Li, Chen Zhang

✧ **Hybrid Energy Systems and Power Generation Technology**

A Combined Data-Driven and Simulation Approach for Wind Turbine Blade Icing Prediction in Cold Regions 496

Yangyang Wu, Huayu Yuan, Tianshu Wen

Collaborative Planning Strategy of the PV-ES Joint System in Park Considering Multi-user Bidding 503

Yun Miao, Fei Wang, Yan Li, Xiaobo Liu, Yuchao Luo

Research on Intelligent Selection Methods for Similar Days Based on Meteorological Factors for Prediction of New Energy Station Power Generation 508
Weiqing Cao, Qinsheng Yang, Yongjin Zhu, Zhiying Zhong, Qing Ye, Xiaohui Fu

Design of Energy Information Collection and Analysis Terminal with Digital Edge Computing Capabilities 514
Xiao Peng, Bingxiang Luo, Zihao Lu, Lu Zhang, Yupeng Liu

A Short-Term Prediction Method for Photovoltaic Power Based on Similar Daily Set Training of Meteorological Data 523
Peng Luo, Sheng Wang, Chensong Liu

Deep Learning-Based Power Generation Prediction for Photovoltaic Buildings 530
Mou Liang, Jing Wang, Jialun Wan, Yao Cai, Jingwen Chen, *Shunli Ding*

✧ Electricity Trading and Market Optimization in Intelligent Power Systems

Research and Application of Electricity Index in Jiangsu Power Market Transactions 536
Qingqing Huang, Yi Yu, Xinyi Chen, Mingxi Shen, Yuyu Kang, Siyu Yan

A ConvNeXt-backbone cGAN for Underwater Power Engineering Image Enhancement 541
Tiebin Chen, Suxun Zhu, Bowen Ren, Laijun Chen

Operational Risk Assessment of Power System with Demand-side Flexible Resources: An end-to-end Multi-task Learning Approach 547
Meng Liu, Daning You, Xiaoyu Zeng

Research on Power Prediction and Evaluation System of Agency Power Purchase Business Based on Intelligent Algorithms—A Case Study of Jiangsu Province 553
Lingli Long, Kunming Li, Yongjin Zhu, Jike Ma, Cong Ji, Wen Yong

Modeling of Evaluation Index System for Coordinated Operation of Wind-solar-hydro Multi energy Complementary Systems at Multiple Time Scales 558
Danni Shi, Jie Li, Bo Chai, Siyan Liu, Yishen Wang, Xinghua Shi

Realization Technology of Real-time Power Reporting Based on AnalyticDB 565
Jike Ma, Yunlong Wang, Shuai Shuai, Zhipeng Xu, Zhiying Zhong, Qing Ye, *Xiaohui Fu*

Research on Technical and Economic Calculation Method Based on Digital Model of Ultra High Voltage Engineering 570
Shutao Dong, Kun Xu, Chunlin Li, Xiangshang Wang, Jianguang Zhang, Jingguo Rong

Research on Key Data Interaction Models of Transregional and Trans-provincial Power Exchange Settlement 576
Jun Xu, Suyan Long, Wen Xie, Yifan Wang, Jingchen Dong, Lin Zhou

Integrating Multi-source Data for CO2 Emission Prediction at City and County Level – A Case Study in Shanxi Province, China 581
Jin Zhao, Weiru Wang, Huiping Zheng, Xueting Cheng, Mengzan Li

Site Selection and Capacity Planning for Distributed Generation Considering Uncertainty Risk and Lack of Flexibility 588

Yang Hu-ping, Gong Jianing, He Tao, Cao Zhengdong, Liu Jiale

✧ Electric Power Communication and Energy Internet

Research on Network Slicing Resource Prediction Method Based on Ring Federated Learning 593

Donglan Liu, Yingxian Chang, Rui Wang, Lili Sun, Yong Wang, Fangzhe Zhang, Honglei Yao, Hao Zhang

Research on the Collaborative Evolution Technology Path of Standard Essential Patents for New Power Systems 598

Ding Peng, Deng Tao, Ma Chao, Zhang Guang, Liu Jian, She Jun, Cai Dongyang

Research on Energy Consumption Optimization Method of 5G Base Station Based on Federation Learning 603

Donglan Liu, Xin Liu, Rui Wang, Lili Sun, Peng Zhao, Yingxian Chang, Honglei Yao, Hao Zhang

Research on a Full Factor Perceived Transmission IoT System.....608

Deng Feng, Zhang Ke, Cao Donghong, Ren Shuai

Active Distribution Network Differential Synchronization Integrated Protection Scheme Based on 5G Communication.....614

Bingsen Xia, Yuanchun Tang

Author Index