

## 《电力电容器与无功补偿》 第4届编委会名单

主任委员：元复兴

副主任委员：周会高

委员：(以姓氏笔画为序)

王耀 王崇祜 刘水平 同向前  
汲胜昌 张万荣 张丹丹 张建平  
张建军 张春朋 李化 李电  
李志远 杨一民 陈才明 张勇军  
肖遥 张怿宁 卓放 段晓波  
祝令瑜 倪学锋 徐政 党智敏  
袁铁江 梁琼 贾华 黄莹  
葛磊蛟 葛锦萍 储松潮 翁利民  
薛畔

中文核心期刊

中国期刊全文数据库全文收录期刊

万方数据库数字化期刊群入网期刊

中国期刊订阅指南信息库收录期刊

第四届陕西省科技期刊优秀期刊奖

主管、主办：西安电力电容器研究所

编辑、出版：《电力电容器与无功补偿》

编辑部

总 编：周会高

主 编：杨佩侠

责任编辑：杨文荣 谭艺玲

编 辑：于淑霞

地 址：西安市西二环北段18号

邮政编码：710077

电 话：(029)84221423

传 真：(029)84221423

在线投稿：[www.dldrq.com](http://www.dldrq.com)

电子邮箱：[dldrqxb@163.com](mailto:dldrqxb@163.com)

[dldrq@126.com](mailto:dldrq@126.com)

出版日期：2020年12月25日

印 刷：西安新华印务有限公司

国内发行：陕西省邮政报刊发行局

订 购 处：全国各地邮局

中国标准连续：ISSN 1674-1757  
出 版 物 号：CN 61-1468/TM

邮发代号：52-13

每期定价：¥15.00元/本

广告经营许可证号：6101004001036

## 目 次

### ● 无功补偿与滤波 ●

并联电容器装置投切的仿真分析与试验研究

..... 盖斌,蔡俊,赵亮,高超(1)

宜都换流站直流滤波器电容器  $C_1$  不平衡保护频繁告警原因分析及解决措施

..... 吴嘉琪,陈飞,谭静,甘晟,康守亚,王枫(8)

基于用电信息采集系统的台区无功补偿方案评估

..... 李娜,王璐,齐尚敏,山宪武,韩鑫磊,任涛(15)

基于混合整数凸规划的有源配电网重构与无功电压协调优化

..... 陈永进(21)

750 kV 串补关键设备状态自评估系统研究

..... 祁宝才,李永滨,马顺绪,李斌,喻劲松,穆春俊(30)

基于无功调节的 VSC-MTDC 系统暂稳控制策略

..... 葛鹏江,张亚鹏,屈高强,郭宁,高玉喜(37)

计及 STATCOM 的受端换流站容性无功配置策略研究

..... 袁康龙,聂金峰,陈雷,郭经韬(44)

一种改善 SVG 动静态特性的无源性控制方法

..... 常乾坤,汪伟,袁清芳,贾东强,王海云,戴笃猛,袁敞(50)

### ● 电容式电压互感器 ●

基于主元分析与核偏最小二乘的 CVT 误差在线检测方法

..... 王春雨,于海波,赵晓健,赵进全(57)

### ● 配套设备 ●

干式空心电抗器匝间短路故障投切过电压有限元分析

..... 王硕,张轶珠,王昕(63)

基于频响函数干式空心电抗器噪声预估方法研究

..... 张嵩阳,祝令瑜,汲胜昌,王磊磊,杨航,王广周,王东晖(71)

基于加密测点的干式空心平波电抗器声场分布特性

..... 何强,樊超,王斌,崔建业,赵寿生,肖伟民(78)

基于大数据的电子式互感器设备状态在线监测设计

..... 陈刚,徐敏锐,穆小星,郭云春,陈飞,黄道(83)

## ● 系统应用研究 ●

超级电容器在配电网供电可靠性中的仿真分析

..... 刘永礼,康文韬,刘恒勇,欧阳光,龙杭,刘鹏飞(89)

基于超级电容储能的暂态电压主动防御装置在解决化工企业晃电中的应用

..... 赵坤,张勇,孙增平,李矿,魏斌,张建(96)

适于单相电压的抗复合扰动的电压暂降快速检测法 ..... 郭春林,马凯,张家铭,张琛亮,杨琳(102)

基于能量互补的次同步振荡宽频带抑制策略研究

..... 于弘洋,王英沛,胡韵婷,于敬帅,赵国亮,邓占锋,高本锋(108)

基于低压配电网三相负荷不平衡时的自决策方案研究

..... 杨成钢,赵建文,金华芳,林峰,傅颖,胡志宏(115)

基于精确反馈线性化的 Boost 变换器自适应反演滑模控制

..... 张衡,谷志锋,尹志勇,刘正春,冯高辉,杨海涛,张燕芬(120)

基于混合卷积窗三谱线插值的介损角测量方法

..... 张强,王海云,王维庆,萨妮耶·麦合木提(125)

用于馈线互联的柔性多状态开关研究

..... 彭翠萍,秉梦涵,刘水,高士森,卫才猛,郭琳,林杰欢,霍群海(132)

三相电压源型 PWM 整流器鲁棒自适应控制 ..... 沈雪红,陈才学(137)

考虑电压暂降耐受曲线不确定区域的设备故障概率评估

..... 汪伟,常乾坤,于希娟,张再驰,陈茜,汪坤(142)

负载模拟器的电流跟踪性能与电感参数选取 ..... 刘威,朱长青,谷志锋(150)

## ● 清洁能源领域应用技术 ●

风电高渗透率电网的经济优化调度 ..... 蔡逸超,杜欣慧,王质素,李钢(156)

风储联合系统的电池分组控制策略 ..... 贺敬,张仰飞,苗风麟,张小莲,陈冲(162)

光伏电站暂态特性仿真与分析 ..... 贺素霞,乐丽琴(168)

风电机组参与一次调频的自适应控制方法

..... 吉静,郝丽丽,王昊昊,谢东亮,李威,周彦彤(174)

风电场等值模型准确度评价研究综述 ..... 朱乾龙,齐盟(180)

深冷液化空气储能系统热力学建模与效率分析 ..... 杨德州,贾春荣,迟昆,李媛(185)

变电站用阀控式铅酸蓄电池浮充寿命研究 ..... 葛礼嘉,宋政湘,张国钢(191)

基于二阶电路的铅碳电池模型与实验研究 ..... 李华,吴杰,曲德宇,丛培杰(196)

液态金属电池串联均衡电路的设计 ..... 徐钦,黄青丹,饶锐,宋浩永,赵崇智,刘静(202)

退役阀控铅酸电池性能的实验研究 ..... 刘珊,蔡蒂,张锐健,曲德宇,吴杰(207)

● 2020 年《电力电容器与无功补偿》总索引 ● ..... ( I )

● 广告单位 ● ..... (62)

## CONTENTS

### ● Reactive Power Compensation and Filter ●

- Simulation Analysis and Test Study on Switching of Shunt Capacitor Device ..... GAI Bin, CAI Jun, ZHAO Liang, GAO Chao(1)  
Analysis and Solution on Frequent Warning of Unbalance Protection of DC Filter Capacitor  $C_1$  at Yidu Converter Station ..... WU Jiaqi, CHEN Fei, TAN Jing, GAN Shen, KANG Shouya, WANG Feng(8)  
Evaluation of Reactive Power Compensation Scheme Based on Electricity Information Acquisition System ..... LI Na, WANG Lu, QI Shangmin, SHAN Xianwu, HAN Xinlei, REN Tao(15)  
A Coordinated Optimization for Active Distribution Network Reconfiguration and Volt/var Optimization Based on Mixed Integer Convex Programming ..... CHEN Yongjin(21)  
Self-evaluation System Research for 750 kV SC Key Equipment ..... QI Baocai, LI Yongbin, MA Shunxu, LI Bin, YU Jinsong, MU Chunjun(30)  
Transient Stability Control Strategy of VSC-MTDC System Based on Reactive Power Regulation ..... GE Pengjiang, ZHANG Yapeng, QU Gaoqiang, GUO Ning, GAO Yuxi(37)  
Study on Capacitive Reactive Power Allocation of Receiving Converter Station Considering STATCOM ..... YUAN Kanglong, NIE Jinfeng, CHEN Lei, GUO Jingtao(44)  
Passive Control Method for Improving the Dynamic and Static Characteristics of SVG ..... CHANG Qiankun, WANG Wei, YUAN Qingfang, JIA Dongqiang, WANG Haiyun, DAI Dumeng, YUAN Chang(50)

### ● Capacitor Voltage Transformer ●

- Online Detection Method of CVT Error Based on Principal Component Analysis and Kernel Partial Least Squares ..... WANG Chunyu, YU Haibo, ZHAO Xiaojian, ZHAO Jinquan(57)

### ● Auxiliary Equipment ●

- Finite Element Analysis of Switching Overvoltage of Dry-type Air Core Reactor ..... WANG Shuo, ZHANG Yizhu, WANG Xin(63)  
Noise Predicting Method of Dry-type Air-core Reactor Based on the Frequency-response Function ..... ZHANG Songyang, ZHU Lingyu, JI Shengchang, WANG Leilei, YANG Hang, WANG Guangzhou, WANG Donghui(71)  
Acoustic Field Distribution Characteristics of Dry-type Air-core Smoothing Reactor Based on Encryption Measuring Point ..... HE Qiang, FAN Chao, WANG Bin, CUI Jianye, ZHAO Shousheng, XIAO Weimin(78)  
On-line Monitoring Design on Electronic Instrument Transformer Based on Big Data ..... CHEN Gang, XU Minrui, MU Xiaoxing, GUO Yunchun, CHEN Fei, HUANG Dao(83)

### ● Research on System Application ●

- Simulation Analysis of Super Capacitor in Power Supply Reliability of Distribution Network ..... LIU Yongli, KANG Wentao, LIU Hengyong, OUYANG Guang, LONG Hang, LIU Pengfei(89)  
Application of Transient Voltage Active Adjustment Voltage System Based on Ultra-capacitor Charge in Solving Power Shaking of Chemical Enterprise ..... ZHAO Kun, ZHANG Yong, SUN Zengping, LI Kuang, WEI Bin, ZHANG Jian(96)  
Voltage Sag Fast Detection Method for Anti-composite Perturbation for Single-phase Voltage ..... GUO Chunlin, MA Kai, ZHANG Jiaming, ZHANG Chenliang, YANG Lin(102)

- Wide-band Suppression Strategy of Sub-synchronous Oscillation Based on Energy Complementation ..... YU Hongyang, WANG Yingpei, HU Yunting, YU Jingshuai, ZHAO Guoliang, DENG Zhanfeng, GAO Benfeng(108)
- Self-decision Scheme for Three-phase Load Unbalance in Low Voltage Distribution Network ..... YANG Chenggang, ZHAO Jianwen, JIN Huafang, LIN Feng, FU Ying, HU Zhihong(115)
- Adaptive Backstepping Sliding Mode Control of Boost Converter Based on Precise Feedback Linearization ..... ZHANG Heng, GU Zhifeng, YIN Zhiyong, LIU Zhengchun, FENG Gaohui, YANG Haitao, ZHANG Yanfen(120)
- Dielectric Loss Angle Measurement Method Based on Mixed Convolution Window with Three Spectral Lines Interpolation ..... ZHANG Qiang, WANG Haiyun, WANG Weiqing, SANIYE·Maihemut(125)
- Study on Flexible Multi-state Switch for Feeder Interconnection ..... PENG Cuiping, SU Menghan, LIU Shui, GAO Shisen, WEI Caimeng, GUO Lin, LIN Jiehuan, HUO Qunhai(132)
- Robust Adaptive Control for Three-phase Voltage Source PWM Rectifier ..... SHEN Xuehong, CHEN Caixue(137)
- Probability Assessment of Equipment Fault Considering Uncertainty Region of Tolerance Curves for Voltage Sags ..... WANG Wei, CHANG Qiankun, YU Xijuan, ZHANG Zaichi, CHEN Qian, WANG Kun(142)
- Current Tracking Performance and Inductance Parameter Selection of Load Simulator ..... LIU Wei, ZHU Changqing, GU Zhifeng(150)
- Application Technology in the Field of Clean Energy ●**
- Economic Optimization of Wind Power High Permeability Grid ..... CAI Yichao, DU Xinhui, WANG Zhisu, LI Gang(156)
- Battery Grouping Control Method of Wind-storage System ..... HE Jing, ZHANG Yangfei, MIAO Fenglin, ZHANG Xiaolian, CHEN Chong(162)
- Simulation and Analysis for Transients of PV Power Station ..... HE Suxia, YUE Liqin(168)
- Adaptive Control Method for Wind Turbines Participating in Primary Frequency Regulation ..... JI Jing, HAO Lili, WANG Haohao, XIE Dongliang, LI Wei, ZHOU Yantong(174)
- Review on Accuracy Evaluation of Equivalent Model of Wind Farm ..... ZHU Qianlong, QI Meng(180)
- Thermodynamic Modeling and Efficiency Analysis of Liquid Air Energy Storage ..... YANG Dezhou, JIA Chunrong, CHI Kun, LI Yuan(185)
- Study on Float Life of Valve Regulated Lead Acid Batteries for Substation ..... GE Lijia, SONG Zhengxiang, ZHANG Guogang(191)
- Lead Carbon Battery Model and Experimental Study Based on Second-order Circuit ..... LI Hua, WU Jie, QU Deyu, CONG Peijie(196)
- Design on Series Equalization Circuit of Liquid Metal Battery ..... XU Qin, HUANG Qindan, RAO Rui, SONG Haoyong, ZHAO Chongzhi, LIU Jing(202)
- Experimental Study on Performance of Retired VRLA Battery ..... LIU Shan, CAI Di, ZHANG Ruijian, QU Deyu, WU Jie(207)

---

**Sponsored by:**Xi'an Power Capacitor Research Institute

**Edited by:**Editorial Office of POWER CAPACITOR & REACTIVE POWER COMPENSATION

**General Editor:**ZHOU Huigao

**Chief Editor:**YANG Peixia

**Add:**No.18, the North of the No.2 West Ring Road, Xi'an, Shaanxi 710077, P.R.China

**Tel:**+86-29-84221423

**Fax:**+86-29-84221423

**Website:**[www.dldrq.com](http://www.dldrq.com)

**Email:**dldrqxb@163.com dldrq@126.com

**Distributed by:**Shaanxi Office of Postal Service

**版权声明**

1.本刊对发表的文章拥有出版电子版、网络版版权，并拥有与其他网站交换信息的权利。本刊支付的稿酬已包含以上费用。

2.本刊文章版权所有，未经书面许可，不得以任何形式转载。