CONFERENCE PROGRAM

ACEEE 2024

2024 7TH ASIA CONFERENCE ON ENERGY AND ELECTRICAL ENGINEERING

2024年第7届亚洲能源与电气工程会议

ICPSG

2024 7TH INTERNATIONAL CONFERENCE ON POWER AND SMART GRID

2024年第7届电力与智能电网国际会议

成都

July 20-22, 2024

Chengdu, China

2024

CONFERENCE PROGRAM

2024 7th Asia Conference on Energy and Electrical Engineering

2024 年第 7 届亚洲能源与电气工程会议

2024 7th International Conference on Power and Smart Grid (ICPSG 2024)
2024 第 7 届电力与智能电网国际会议

July 20-22, 2024 | Chengdu, China | UTC+8 (China Standard Time)

成都望江宾馆
Wangjiang Hotel

中国四川省成都市锦江区下沙河铺街 42 号
No.42 Xiashahepu Street, Jinjiang District, Chengdu, Sichuan, China

Co-sponsored by

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GENERAL INFORMATION

A Conference Venue & Zoom Meeting ID

成都望江宾馆 WANGJIANG HOTEL

中国四川省成都市锦江区下沙河铺街 42 号
No.42 Xiashahepu Street, Jinjiang District, Chengdu, Sichuan, China

会议住宿请参会人员参照以下方式自行预订：

1.官方网站（电脑端操作）预定：www.wangjianghotel.com，在预订客房里输入预订促销代码“ACEEE2024”。

2.手机预订：打开微信，扫描“成都融通望江宾馆”微信公众号二维码，在宾馆官方微信公众号的“微官网”里输入促销代码“ACEEE2024”。

3.电话预订:望江宾馆预订部：028-84090060

	Meeting Room	Zoom ID	Meeting Link
zoom Download (Click)	A	891 3234 0852	https://us02web.zoom.us/j/89132340852
	B	845 1815 9740	https://us02web.zoom.us/j/84518159740

◆Name Setting

Keynote Speaker: KN-Name

Committee: Position-Name

Author: Paper ID-Name

Delegate: Delegate-Name

◆Useful Links

Conference Banner (click)

Zoom Background (click)

B Onsite Registration

Registration desk (Hotel Lobby) → Inform the staff of your paper ID→ Sign-in→ Claim your conference kit.

C Devices Provided by the Organizer

Oral Session: Laptops (with MS-Office & Adobe Reader) / Projectors & Screen / Laser Sticks

Poster Session: Double-sided poster stand

D Devices Provided by the Organizer

Oral Session: Slides (pptx or pdf version). Format 16:9 is preferred.

Poster Session: A1 (Length: 841mm, width:594mm) size poster. If you need printing service provided by conference organizer, please email us your posters before 17:00 July 15, 2024.

GENERAL INFORMATION

E Duration of Each Presentation

Keynote Speech: 40min, including Q&A.

Invited Talk: 25min, including Q&A.

Oral Session: 15min, including Q&A.

Poster Session: 10min, including Q&A.

F Notice

※ Please wear your delegate badge (name tag) for all the conference activities. Lending your participant card to others is not allowed.

※ Please take good care of your valuables at any time during the conference. The conference organizer does not assume any responsibility for the loss of personal belongings of the participants during conference day.

※ **UTC+8, China Standard Time (CST).** Please be aware of time difference between this and your region/country.

G Contact Us

ACEEE 2024

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ICPSG 2024

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WELCOME MESSAGE

Dear All,

Welcome to the joint conference of 2024 7th Asia Conference on Energy and Electrical Engineering (ACEEE 2024) and 2024 7th International Conference on Power and Smart Grid (ICPSG 2024), held in Chengdu, from July 20 to 22, 2024. The conferences are co-sponsored by University of Electronic Science and Technology of China, Beijing CAS Industrial Energy and Environment Technology Institute (BIEET) and IEEE, hosted by School of Mechanical and Electrical Engineering (UESTC, China), supported by King Mongkut's University of Technology North Bangkok, Thailand.

The annual international conferences are aimed to bring together the researchers, experts, and scholars around the world to exchange their research results and address open issues in related fields. We hope ACEEE x ICPSG 2024 would be able to achieve its objective in providing an effective forum for academician, researchers, and practitioners to advancing knowledge, research, and technology for humanity.

2024 Chengdu conferences will consist of 4 keynote speeches, delivered by Prof. Nikos D. Hatziargyriou (FIEEE, National Technical University of Athens, Greece), Prof. Carlo Alberto Nucci (FIEEE, University of Bologna, Italy), Prof. Zhaoyang DONG (FIEEE, City University of Hong Kong, China), and Mr. Te Zhou (Sichuan Energy Internet Research Institute, Tsinghua University, China). 3 invited talks from Prof. Dr. Saim Memon (CEO & Industrial Professor of Renewable Energy Engineering, Department of Industrial R&D in Vacuum Insulation Energy Technologies, Sanyou London Pvt Ltd, UK), Assoc. Prof. Chengxin Li (Sichuan University, China), Asst. Prof. Kaikai Pan (Zhejiang University, China), followed by 4 oral sessions, 2 poster sessions, and 2 online sessions.

It is pleasing to note that the agenda of this conference covers a wide range of interesting topics related to all theoretical and practical aspects, but not limited to modern power system and power transmission technology, optimizing operation and market analysis of intelligent power system, electrical faults and power load prediction, voltage control and functional analysis in electrical equipment, etc.

The papers in the proceedings are accepted after being peer-reviewed by conference committee, international reviewers based on the topic and quality. With the keynote speeches, invited speeches, parallel sessions, we'll have an exciting program this year, which will allow participants to present and discuss the latest research and industrial developments in these fields.

On behalf of the organizing committee, we would like to deeply express our heartfelt appreciation to all our delegates, keynote speakers, invited speakers, session chairs, as well as all the committee members involved in the technical evaluation of conference papers and in the organization of the conference for their time, effort, and great contributions.

We also wish that these conferences will be an unforgettable and wonderful experience for you.

With Warmest Regards,

Conference Organizing Committees

ACEEE x ICPSG 2024

Chengdu

CONFERENCE COMMITTEE

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Saim Memon, University of Huddersfield, UK

AGENDA OVERVIEW (UTC+8)

Saturday, July 20, 2024		
Onsite Registration	10:00-17:00	1F Lobby - Wangjiang Hotel 成都望江宾馆
Zoom Test for Online Presenters	14:00-16:00	**Zoom** Room A: 891 3234 0852

Zoom Test Timetable

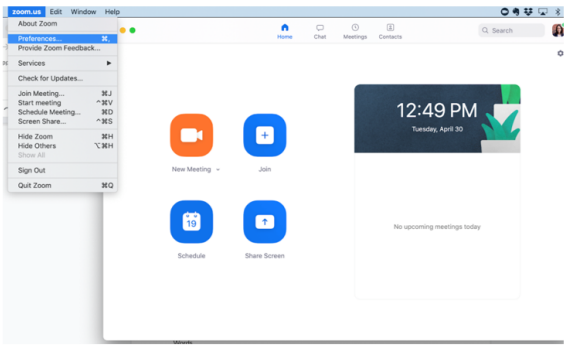
- ✧ Participants who are going to do an online presentation are required to join the rehearsal in Zoom on Saturday, July 20, 2024. Duration: 2-3min apiece. Feel free to leave after you finish the test.
- ✧ We will test control panel including screen sharing, audio, video and "Raise Hand" feature, etc. Please get your presentation slides and computer equipment prepared beforehand.

14:00-14:30	AC880 AC814 AC819 AC8003 AC8009 AC902 AC903 AC904 AC804 AC882 AC831 AC908
14:30-15:00	AC812 AC816 AC820 AC821 AC809 AC829 AC836 AC877 AC923 AC920 AC870 AC823
15:00-16:00	Other online participants, includes but not limited to keynote speakers, invited speakers, session chairs, committee members, delegates. Participants who are unavailable during the above allocated time can also join the rehearsal at 15:00-16:00.

Zoom Guidance

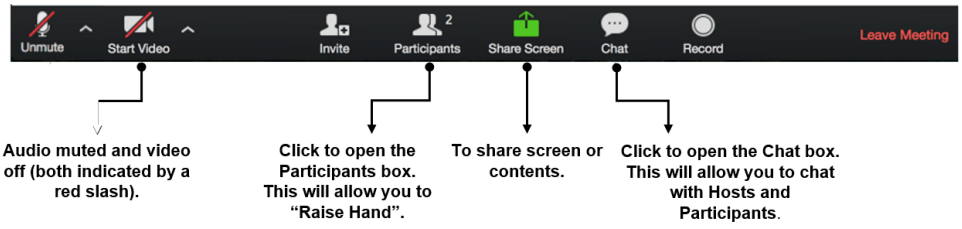
You can join the meeting without sign-in process.
Just put the meeting ID and join us.

URL: https://zoom.us/download



Each meeting has a unique **9, 10, or 11-digit** number called a **meeting ID** that will be required to join a Zoom meeting.

For any questions on the meeting day, you can text privately to "Assistant" for help.



AGENDA OVERVIEW (UTC+8)

Sunday, July 21, 2024	
Sentosa Island 圣淘沙岛 4F	**Zoom** Room A: 891 3234 0852
CHAIRPERSON: **Meng Zhou**, University of Electronic Science and Technology of China (UESTC), China	
09:00-09:10	OPENING SPEECH **Yang Han - General Chair** Professor, University of Electronic Science and Technology of China (UESTC), China
09:10-09:50	KEYNOTE SPEECH I **Zhaoyang DONG** Professor, Fellow of IEEE, City University of Hong Kong, China "AI-Enhanced Emission Estimation and Key Index for ESG Compliance"
09:50-10:30	KEYNOTE SPEECH II **Te Zhou** Sichuan Energy Internet Research Institute, Tsinghua University, China "Synthetic Inertia Control Strategy for Thermostatically Controlled Load Cluster"
10:30-11:00	Group Photo & Coffee Break
11:00-11:40	KEYNOTE SPEECH III **Carlo Alberto Nucci** Professor, Fellow of IEEE, University of Bologna, Italy "Pathways to Climate Neutrality: The Role of Smart Ci7es and Renewable Energy in the EU context"
11:40-12:20	KEYNOTE SPEECH IV **Nikos D. Hatziargyriou** Professor, Fellow of IEEE, National Technical University of Athens, Greece "Exploiting the Flexibility of Distributed Energy Resources"
12:20-13:30	Lunch Buffet <Phuket Island 普吉岛 1F >

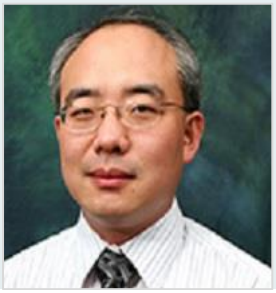
Parallel Session (Onsite) Sunday, July 21, 2024		
13:30-15:40	**Oral Session 1: Voltage Control and Functional Analysis in Electrical Equipment** Invited Talk: Chengxin Li AC851 AC857 AC885 AC901 AC833 AC917 AC916	Sentosa Island 圣淘沙岛 4F
	Oral Session 2: Development of Intelligent Power Equipment and Devices AC822 AC838 AC861 AC875 AC884 AC8001 AC873	Kedah 吉打 4F
	Poster Session 1: Intelligent Power Control System Model, Reliability Analysis and Safety Evaluation AC872 AC834 AC844 AC813 AC830 AC840 AC862 AC863 AC883 AC912	4F
15:40-16:00	Coffee Break 4F	
16:00-17:30	**Oral Session 3: Electrical Faults and Power Load Prediction** AC865 AC803 AC818 AC918 AC825 AC868-A	Sentosa Island 圣淘沙岛 4F
	Oral Session 4: Modern Integrated Energy System AC856 AC805-A AC801 AC849 AC855 AC832	Kedah 吉打 4F
	Poster Session 2: Load Forecasting, Optimized Scheduling, and Energy Storage in Presentations: Modern Power Systems AC848 AC866 AC879 AC859 AC864 AC871 AC878 AC907 AC910 AC915 AC860 AC810	4F
18:00-20:00	Dinner Buffet <Phuket Island 普吉岛 1F >	

AGENDA OVERVIEW (UTC+8)

Parallel Session (Online) Sunday, July 21, 2024		
14:00-17:35	**Online Session 1: Modern Power System and Power Transmission Technology** Invited Talk: Saim Memon Part A: AC880 AC814 AC819 AC8003 AC8009 (breaktime: 10min) Part B: AC902 AC903 AC904 AC804 AC882 AC831 AC908	Room A: 891 3234 0852
14:00-17:35	**Online Session 2: Optimizing Operation and Market Analysis of Intelligent Power System** Invited Talk: Kaikai Pan Part A: AC812 AC816 AC820 AC821 AC809 (breaktime: 10min) Part B: AC829 AC836 AC877 AC923 AC920 AC870 AC823	Room B: 845 1815 9740

Note: We will take a group photo at the end of each parallel session, please stay in the meeting room until your session is over. Thanks!

INTRODUCTION OF KEYNOTE SPEAKER



Zhaoyang DONG

Professor, Fellow of IEEE
City University of Hong Kong
China

Speech Title:

AI-Enhanced Emission Estimation and Key Index for ESG Compliance

Abstract: Accurate carbon emission accounting is crucial for combatting climate change and fulfilling Environmental, Social, and Governance (ESG) reporting standards, which are increasingly mandated for listed companies to meet international regulatory and market expectations. This presentation introduces a key index method and an AI-enhanced emission estimation framework, addressing the needs and limitations of current methodologies. Our sustainability index provides a reliable measure for ongoing planning towards sustainability. Emission estimation is achieved through a data-driven approach integrating Scope 1 and Scope 2 emissions, utilizing non-intrusive load monitoring (NILM) algorithms and real-time meter data. Case studies with real data will be presented to validate these methodologies. Additionally, our framework correlates key energy-relevant parameters with emission levels, offering a valuable index for businesses to monitor and reduce their carbon footprint with high accuracy. Real-time estimation enables proactive emissions tracking, empowering informed decision-making for sustainable practices.

Bio: Prof ZY Dong is a Chair Professor of Electrical Engineering and Head of the Department of Electrical Engineering, City University of Hong Kong. His previous roles include Singapore Power Group (SPG) Endowed Professor and Co-Director of SPG-NTU Joint Lab at Nanyang Technological University, Singapore; SHARP Professor of Energy Systems and inaugural Director of UNSW Digital Grid Futures Institute, Director of ARC research Hub For Integrated Energy Storage Solutions, the University of NSW (UNSW), Australia; Ausgrid Chair Professor and Directo of Ausgrid Centre for Intelligent Electricity Network provided R&D support for the AUD500m Smart Grid, Smart City National Demonstration Project of Australia. His research interests include power system planning, renewable energy systems, smart grid, smart city and computational methods for power system analysis. He is a Fellow of IEEE and has served as editorial board member of a number of IEEE Transactions and IET Journals.

INTRODUCTION OF KEYNOTE SPEAKER

Nikos D. Hatziargyriou

Professor, Fellow of IEEE
National Technical University of Athens
Greece

Speech Title:

Exploiting the Flexibility of Distributed Energy Resources

Abstract: The lecture will provide an overview of current RES development and the main challenges this presents to the steady state and dynamic performance of power distribution systems. It will focus on the increased flexibility needs and the flexibility sources currently available. It will then provide an overview of the flexibility market structures discussed and the experiences of pilot projects and practices in Europe.

Bio: Nikos Hatziargyriou is with the National Technical University of Athens (NTUA), professor in Power Systems, since 1995, and Professor Emeritus, since 2022. He is Part-time Professor at the University of Vaasa, Finland. He has over 10 year industrial experience as Chair and CEO of the Hellenic Distribution Network Operator (HEDNO) and as executive Vice-Chair and Deputy CEO of the Public Power Corporation (PPC). He has participated in more than 60 R&I projects funded by the EU Commission, electric utilities and industry for fundamental research and practical applications. He is author of more than 300 journal and 600 conference proceedings papers, he is included in the 2016, 2017 and 2019 Thomson Reuters lists of top 1% most cited researchers and he is 2020 Globe Energy Prize laureate, the 2017 recipient of the IEEE/PES Prabha S. Kundur Power System Dynamics and Control Award and the 2023 recipient of the IEEE Herman Halperin Electric Transmission and Distribution Award.

INTRODUCTION OF KEYNOTE SPEAKER

Carlo Alberto Nucci

Professor, Fellow of IEEE
University of Bologna
Italy

Speech Title:

Pathways to Climate Neutrality: The Role of Smart Ci7es and Renewable Energy in the EU context

Abstract: The goal of achieving global climate neutrality thanks to the energy transition envisaged by the Conference of Parties and the EU Green Deal is discussed, with a focus on cities, energy production and consumption. The still high consumption of fossil fuels requires multiple efforts: from improving the efficiency of existing power plants, to transitioning from fossil fuel sources to less climate-altering ones. The use of renewable sources such as solar, wind and hydroelectric energy is increasingly crucial. The gradual electrification of various sectors and differentiation to avoid dependence on sources on the one hand and on materials and technologies on the other are considered a key strategy for the energy transition. Research into hydrogen and nuclear energy is also considered an essential element of a diversified energy strategy. Prosumer renewable energy communities, encouraged by European directives, could potentially generate 20% of cities' energy consumption by 2030, highlighting the importance of electricity systems and smart grids. In this context, Europe aims to support 100 cities to become climate neutral by 2030 through the Climate Neutral and Smart Cities mission, promoting innovation and providing 100 concrete examples to other cities to achieve climate neutrality by 2050. To assist the selected cities, Europe plans to contribute with financial instruments, regulatory measures and a 'climate city contract' (CCC). The speech will deal with these issues.

Bio: Carlo Alberto Nucci is a Full Professor and Head of the Power Systems Laboratory of the Department of Electrical, Electronic and Information Engineering "Guglielmo Marconi", University of Bologna.

Responsible of several research projects financed by the Italian Ministry of Research, by the Italian Science Foundation (C.N.R.), by European Commission and of several research contracts financed by Italian and foreign companies and universities. Author/co-author of more than 370 scientific articles published in peer-reviewed journals or international conference proceedings and of 13 chapters of internationally distributed books on the following topics: lightning interaction with power systems, restoration processes after blackouts, power systems dynamics, smart grids, smart cities and renewable energy communities. Prof. Nucci is a Fellow of the IEEE, of the International Council on Large Electric Systems (CIGRE), of which he is also an Honorary member, and of the Chinese Society of Electrical Engineering, CSEE. Has served as chair of panel of the 2022 Call for Exploratory Research Projects under the MIT Portugal Program. Prof. Nucci has also served as Editor-in-Chief of the Electric Power Systems Research journal (Elsevier) from 2010 to 2021. He has served as Deputy Dean of the Faculty of Engineering from 2008 to 2012, as the President of the Italian Group of the University Professors of Electrical Power Systems (GUSEE) from 2012 to 2015, and as Coordinator of the Bachelor and Master programs in Electrical Energy Engineering from the AY 2012-13 for two consecutive terms (until the 2017-18 AY). He is presently serving as the Italian Representative in the Horizon Europe Mission "Climate-Neutral and Smart cities". He is also serving as the Chair of the International Conference on Lightning Protection, ICLP, as co-chair of the International Conference on Power Systems Transients, IPST and as vice-chair of the Executive Board of the Power Systems Computation Conference. Prof. Nucci is Doctor Honoris Causa of the University Politehnica of Bucharest, a member of the Academy of Science of the Institute of Bologna and a member of the Istituto Lombardo - Science Academy of Milan. He is also distinguished invited Professor at Tsinghua University, Beijing (2023-2026). Invited Keynote plenary speaker and lecturer at some 40 international conferences. Total number of citations (Scopus: 7551, H index: 44. Google Scholar: 13166, H index: 57) – June 2024.

INTRODUCTION OF KEYNOTE SPEAKER

Te Zhou

Sichuan Energy Internet Research Institute
Tsinghua University
China

Speech Title:

Synthetic Inertia Control Strategy for Thermostatically Controlled Load Cluster

Abstract: As the construction of new power system continues to advance, the system inertia level continues to decrease. The inverter-based air conditioning load is huge and contains massive inertia support potential. It is clearly goal-oriented to tap its active inertia support potential. However, distributed small and micro loads have distinctive characteristics such as small single-machine capacity, strong random behavior, and decentralized distribution. They need to participate in grid interaction through cluster aggregation control. There is currently no effective solution for virtual inertia simulation of small and micro load clusters. Starting from the analysis of electric-thermal dynamic characteristics, this report analyzes the load control method applicable to the frequency modulation time scale and gives the response domain. Furthermore, the additional frequency response control strategy for decentralized distributed load clusters under the centralized and decentralized control framework is analyzed. Thus, a power system frequency response model integrating the power-frequency dynamics of the temperature-controlled load cluster is given. Finally, conclusions and prospects are given.

Bio: Te Zhou received the B.Eng. and M.Sc. degrees from Chongqing University, in 2013 and 2016, respectively, both in electrical engineering. He is currently pursuing a doctor degree in electrical engineering at University of Electronic Science and technology of China. Meanwhile, he is currently with Sichuan Energy Internet Research Institute, Tsinghua University. His research interests include low carbon operation and load side frequency regulation in power systems.

INTRODUCTION OF INVITED SPEAKER

Saim Memon

Professor
[1]CEO & Industrial Professor of Renewable Energy Engineering
Department of Industrial R&D in Vacuum Insulation Energy Technologies, Sanyou London Pvt Ltd, UK
[2]Birmingham City University, UK

Speech Title:

Implementing Vacuum Insulation Energy Technologies to Buildings for Net-Zero Energy Infrastructure

Abstract: Vacuum insulation energy technologies such as vacuum insulated wallpaper (VIW), vacuum insulation panel (VIP and decorative integrated VIP are pivotal industrial R&D developments that help in achieving net-zero energy buildings due to their superior thermal efficiency and space-saving attributes. These technologies significantly reduce heat transfer, thereby lowering the energy needed for heating and cooling, aligning with sustainability goals by reducing buildings' carbon footprints. VIW and VIP are particularly effective in extreme climates, offering superior insulation with minimal thickness compared to traditional materials like XPS, EPS, mineral wool, or polyurethane. This results in less space required and lower overall energy consumption. In both cold-arid regions where heating is essential, and hot-arid areas where cooling demands are high, VIPs effectively prevent unwanted heat transfer, enhancing interior comfort while reducing energy use and associated carbon emissions. Overall, the application of VIPs in buildings not only supports stringent building regulations but also contributes to a sustainable, energy-efficient future. This keynote speech focus on addressing global challenges to pave the way for a sustainable, net-zero energy future using vacuum insulation energy technologies.

Bio: Prof. Dr. Saim Memon, CEO and Industrial Professor of Renewable Energy Engineering, unifies academic research and development, industrial manufacturing, and product distribution in the global market. His mission is to shape a sustainable net zero energy future with innovative vacuum insulation energy technologies that empower individuals, homeowners, building contractors, construction projects, organizations, institutions and educators to save their energy consumption realistically.

Prof. Saim has progressed upon his extensive academic experiences to amass a portfolio that includes 120+ research publications, 41 taught modules (including module leadership) in electrical, electronic, mechanical, and renewable energy engineering with over 90% student satisfaction, along with successful supervision of 2+ PhD projects, 12+ MSc/MEng projects, and 23+ BEng (Hons) projects. He has held 50+ invited/keynote speakerships, engaged in research collaborations with 40+ countries worldwide, accumulated 1450+ citations with a 22+ h-index and a 52+ i10-index, served in 5+ editor-in-chief and guest editorships, and fulfilled 40+ journal reviewer roles. Prof. Saim has also demonstrated his academic leadership and made significant contributions to lead research group and MSc/MEng/BEng (Hons) courses directorship and degree apprenticeships with development and validation.

Prof Saim built his academic research career in the UK, earned PhD in Mechanical, Electrical & Manufacturing Engineering; PGCert in Teaching Qualification; MSc in Mechatronics; and BEng (Hons) in Electrical Engineering (1st Class Distinction). Prof Saim is also a Chartered Engineer and a Fellow of Higher Education Academy, holding Qualified Teacher Status granted by General Teaching Council for Scotland in the UK.

Prof Saim has made substantial volunteer contributions over decades, significantly impacting students and the broader community through various elected roles and initiatives. His leadership in the Solar Car Challenge project and UK-Japan projects exemplifies his commitment to practical engineering education. As the founder of many initiatives, he fostered academic-industrial engagement among students, researchers and educators. His extensive involvement in professional organizations underscores his dedication to enhancing academic, industrial and professional environments globally.

INTRODUCTION OF INVITED SPEAKER

Chengxin Li

Associate Professor
Sichuan University
China

Speech Title:

Electric Vehicle Charging Management Model for Residential Communities

Abstract: To solve the problem that electric vehicle disorderly charging in the capacity-constrained communities leads to the surge of electric load, while the properties restrict the private charging piles in order to protect the residents' normal electricity consumption, this paper proposes a model of electric vehicle charging management in residential communities managed by the properties unitedly. Firstly, the electric vehicle charging load model is established; secondly, the charging potential assessment model is established to calculate the charging potential of the community under different circumstances; Finally, a two-phase real-time charging management model considering three-phase load balancing is established considering fluctuations in the time of users returning to the cell, with the first phase predicting the charging load of the cell, and the second phase carrying out real-time charging control of the community vehicle. The example results show that the charging management model proposed in this paper can effectively expand the number of EVs that can be carried in the district, and at the same time, it can better cope with the nighttime load fluctuations caused by the original EV users charging themselves in the district.

Bio: Chengxin Li holds a PhD and is currently serving as an Assoc. Prof. and Vice Dean at the College of Electrical Engineering, Sichuan University. He earned his PhD in electrical engineering in 2012, a Master's in Control Theory and Control Engineering in 2003, and a Bachelor's in Automation in 2000, all from Sichuan University in R.P. China. Since 2017, he's been an Assoc. Prof. in the Dept. of Automation at Sichuan University. He served as a visiting scholar at the University of Sydney and the University of Nottingham from May 2014 to April 2015, and from August 2023 to January 2014, respectively. His research interests focus on the theory and application of load elasticity and loss reduction in distribution networks.

INTRODUCTION OF INVITED SPEAKER

Kaikai Pan

Assistant Professor
Zhejiang University
China

Speech Title:

Towards Cyber-secure RES-integrated Power Systems: Cyber Risk Analysis and Attack Detection

Abstract: The digital transformation and renewable energy source (RES) integration have introduced a new challenge for robustness: cyber security threats in modern power systems. The cyber incidents against power systems, such as the Stuxnet worm attack and the hacker-caused Ukraine blackout, do illustrate the features of a potent attack that can have extensive resources to corrupt multiple data channels by both integrity and availability, and also the strong capability to keep stealthy from possible detectors. The majority of research has focused on pure data integrity or availability attacks from a specific aspect of vulnerability or impact assessment. However, vulnerability or even cyber risk analysis methods for combined attacks and high-threat attacks emerging from RES integration, are lacking and in need to be developed. This talk introduces the author's research works on cyber risk analysis of RES-integrated power systems to high-threat attacks and robust attack detection approaches.

Bio: Dr. Pan is graduated from Delft University of Technology, TU Delft, the Netherlands, under the supervision of Professor Peter Palensky and Professor Peyman Mohajerin Esfahani. In April 2021, he entered the School of Electrical Engineering of Zhejiang University and joined the Intelligent System Security Laboratory (USSLAB). His research interests include new energy system security, unmanned system control security, and information physics system security, etc.

In the past five years, he has completed nearly 30 high-quality academic papers, including 10 journals published in the top journals of the field such as IEEE TPWRS, IEEE TSG, IEEE IEM and so on. Served as the invited editorial board member of the Journal of Modern Power Systems and Clean Energy (MPCE), and as a member of the program committee of EAI SGSC and other international academic conferences.

He is a reviewer of IEEE TSG, TPWRS, IEM, TII, TCST, TIFS and other top journals. He won the First Prize of Science and Technology Progress of the Chinese Society of Electronics in 2022, the Humans of EEMCS Award (Academic Person of the Year) of Delft University of Technology, and the Best Paper Award of IEEE SmartGridComm '17. He is currently a member of IEEE, IEEE PES, ACM, etc.

ORAL SESSION 1

Sunday, July 21, 2024 13:30-15:40	Sentosa Island 圣淘沙岛 4F

Oral Session 1: Voltage Control and Functional Analysis in Electrical Equipment

Chairperson: Dr. Hao Wu, Tianjin University, China

13:30-13:55	Invited Talk	Electric Vehicle Charging Management Model for Residential Communities **Assoc. Prof. Chengxin Li, Sichuan University, China** Abstract-To solve the problem that electric vehicle disorderly charging in the capacity-constrained communities leads to the surge of electric load, while the properties restrict the private charging piles in order to protect the residents' normal electricity consumption, this paper proposes a model of electric vehicle charging management in residential communities managed by the properties unitedly. Firstly, the electric vehicle charging load model is established; secondly, the charging potential assessment model is established to calculate the charging potential of the community under different circumstances; Finally, a two-phase real-time charging management model considering three-phase load balancing is established considering fluctuations in the time of users returning to the cell, with the first phase predicting the charging load of the cell, and the second phase carrying out real-time charging control of the community vehicle. The example results show that the charging management model proposed in this paper can effectively expand the number of EVs that can be carried in the district, and at the same time, it can better cope with the nighttime load fluctuations caused by the original EV users charging themselves in the district.
13:55-14:10	AC851	Coordinated Restoration of Transmission and Distribution Systems with RCs and MEGs *Hao Wu, Tianjin University, China* Abstract-Coordinated restoration of transmission systems (TSs) and distribution systems (DSs) is necessary to reduce load loss after blackouts. Traditional coordination strategies are studied based on the hypothesis of no faults, neglecting fault repairs. To address this issue, a novel coordination method is proposed to integrate the repair and restoration of a coupled TS and DS with repair crews (RCs) and mobile emergency generators (MEGs) during post-disaster repair. Combining fault repairs and generator restarts by RCs and MEGs, a four-stage parallel restoration model is developed to coordinate dynamic partitioning, generation start-up, transmission path energization and load restoration, which facilitates rapid restoration of coupled TS and DS. Finally, the proposed method is validated on T14-D13 systems. The simulation results show that the proposed approach can effectively increase load recovery in the coupled TS and DS during post-disaster repair.
14:10-14:25	AC857	Identification of Partial Discharge State of Transformer Based on Cov-Iradon Transformation-CNN *Qiang Sun, North China Electric Power University,China* Abstract-As an important part of power system, the discharge phenomenon caused by insulation deterioration of power transformer may cause equipment damage. In this paper, corona discharge, air gap discharge and suspension discharge are studied experimentally. Firstly, Covariance (Cov) is used to highlight signal period information and reduce signal noise. Secondly, the inverse Radon transform (Iradon) is used to convert one-dimensional data into two-dimensional images to highlight the characteristic difference between different discharge signals. Finally, convolutional neural network (CNN) is used for state recognition, and the accuracy rate reaches 96.03%.

14:25-14:40	AC885	Research on shaping control method of transient electromagnetic transmission current *Shangshuai Hao, College of Instrumentation Electrical Engineering, Jilin University, China* Abstract-The electromagnetic method is crucial for geophysical exploration, especially in the surveying of mineral and energy resources. The transient electromagnetic (TEM) transmission system, as the core component of electromagnetic detection equipment, directly affects the accuracy of detection results and the stability of the equipment. In high-power ground-air electromagnetic transmission systems, the rising and falling edge characteristics of bipolar square wave current pulses significantly impact the transmitter's performance. To shape the transmission current waveform, this study proposes a new circuit design that includes impedance matching preloading for the rising edge and an active constant voltage clamping technique for the rapid turn-off of the falling edge. This circuit topology can reduce the overshoot of the rising edge by preloading the transmission load impedance matching circuit before the current rises and achieve rapid turn-off through active constant voltage clamping when the transmission current falls, thereby comprehensively improving the quality of the electromagnetic transmission waveform. The effectiveness of the proposed circuit topology and control strategy has been verified through simulation experiments using MATLAB/Simulink.
14:40-14:55	AC901	Research on Transient Overvoltage Calculation of Power Frequency Based on Large-scale Direct Current Outgoing Transmission *Meng Xiangfei, China Electric Power Research Institute, CHINA* Abstract-The continuous operation of ultra-high voltage direct current projects and the rapid development of new energy sources, the grid pattern presents the characteristics of largecapacity direct current and high-proportion new energy centralized access. Direct current bipolar locking leads to the increased overvoltage risk of the terminal system, which greatly affects the scale of direct current supporting new energy delivery. Firstly, the differences and similarities between the horizontal and vertical voltage component method based on power flow calculation and the circuit equivalent replacement method are compared to explore the temporary overvoltage level of power frequency, and then explore the influence degree of various system parameters on the temporary overvoltage level of power frequency. Combined with typical system examples, the temporary overvoltage situation of power frequency of direct current converter bus and new energy gathering station under different operating parameters is verified. Finally, in order to meet the power frequency overvoltage limitation of the high proportion new energy access and large scale direct current outgoing system, the voltage support capability of the power grid is improved by optimizing the parameter setting of new energy and adding dynamic reactive power equipment, which provides reference and guidance for the power grid planning.
14:55-15:10	AC833	Evaluation of Distributed Photovoltaic Admission Capacity in Distribution Grid Considering the Controllable Reactive Power of Inverters *Dian Shao, College of Electrical Engineering, Zhejiang University, China* Abstract-Under the background of “Carbon peaking and carbon neutrality” goals, new energy is widely utilized, especially distributed photovoltaic. The large-scale integration of distributed PV into the distribution grid is a trend for the future distribution grid. Therefore, the calculation of distributed PV admission capacity in the distribution grid is an important issue in distribution grid planning. This paper first establishes an output probability model based on the randomness and uncertainty of distributed PV and load output power. Then handle the relationship between distributed PV and load. With the goal of maximizing distributed PV admission capacity, photovoltaic inverter reactive power control is incorporated. The constraints are constructed and added to the PV admission capacity calculation model, and the stochastic weighted particle swarm optimization algorithm is used for solving the model. Finally, the factors influencing the distributed PV admission capacity in an IEEE 33-bus distribution grid are analyzed.

15:10-15:25	AC917	An Evaluation Method of Voltage Support Capability for Grid-Forming Inverter Applicable for Systems with Various R/X ratios *Yiqian Wang, Shandong University, China* Abstract-With the increasing integration of grid-forming inverters in power systems, it is of great significance to evaluate their voltage support capability to guide the operation of power systems. This paper proposes an evaluation method of voltage support capability for grid-forming inverter applicable for system with various R/X ratios. Firstly, considering the generalized droop control of grid-forming inverter, the amplitude motion model of the grid-forming inverter is built under active and reactive power disturbances. Then two voltage evaluation indicators are proposed, which accounts for the impact of both the active and reactive power on voltage support capability. Based on the two indicators, the influence of control parameters (i.e. voltage loop parameters, droop coefficients) of grid-forming inverter on voltage support capacity is further analyzed. Finally, simulations demonstrate that the proposed evaluation method can effectively evaluate the voltage support capability of grid-forming inverters under active and reactive power disturbances.
15:25-15:40	AC916	Resilience Enhancement Dispatch Method for Distribution Systems Before, During and After Hurricanes *Hao Wu, Tianjin University, China* Abstract-The resilience of distribution system requires to be enhanced to defense hurricanes. However, the existing studies only coordinate the proactive and restoration measure before and after hurricanes, neglecting the resilient operation during hurricanes. Thus, this paper proposes a novel three-stage resilient dispatch model to enhance the resilience of distribution systems. Before hurricanes, mobile emergency generators (MEGs) pre-positioning and proactive islanding schemes are optimized as preparedness measures. During hurricanes, faults isolation by remote-controlled switches (RCSs) and wind power cut-off is considered to improve the survivability of loads. After hurricanes, MEGs re-allocation and faults isolation by manual switches (MSs) are co-optimized to boost the restoration of distribution system. Considering uncertainties of wind power cut-off and line faults, the proposed method is established in a three-stage stochastic dispatching model. Finally, the effectiveness of the novel resilient dispatch model against hurricanes is verified in modified IEEE 33-bus distribution system.

ORAL SESSION 2

Sunday, July 21, 2024 13:30-15:15	Kedah 吉打 4F

Oral Session 2: Development of Intelligent Power Equipment and Devices

Chairperson: Prof. Nedim Tutkun, Istanbul Ticaret University, Turkey

13:30-13:45	AC822	Design and analysis of series dual-excited synchronous machine for power flow control *Tianhuai Qiao, Beijing Jiao tong University, China* Abstract-This article proposes an electromagnetic design method for series dual-excited synchronous machines (SDESMs) in the power flow controller (PFC) based on rotating synchronous machines according to grid demands. Firstly, the operating principle of SDESMs is introduced, and the design method is also provided. The initial structural parameters are obtained by constraining the amplitude and phase of the output voltage. Secondly, the static and transient fields of SDESMs under different excitation winding topologies are calculated, and the optimal winding layout can be acquired through performance comparison. Finally, the influence of different PFC operations on the output voltage, synchronous reactance, and losses in SDESMs is studied, demonstrating the feasibility of the design method and winding structure. The conclusions drawn provide reference and basis for the design, operation, and heat dissipation research of SDESMs.
13:45-14:00	AC838	Effect of Transformer's Distributed Capacitance on Charging Time of Series Resonant Constant Current Charging Power Supply *Zixing Xu, Xi'an Jiaotong University, China* Abstract-Series resonant constant current charging topology is used for charging capacitive power equipment due to its constant current charging characteristics and strong short-circuit protection capability. However, the parasitic parameters of the transformer in the topology will significantly affect the high-frequency current charging characteristics of the power supply, leading to difficulty in precise voltage and current control. Accordingly, this paper analyzes the influence of parasitic parameters on the output characteristics of traditional series resonant converters. Circuit models with equivalent and without parasitic parameters are built on the PSIM platform, and the relationship between transformer-distributed capacitance and charging time is deduced based on simulation results. The results can guide the design of high-frequency series resonant constant current charging power supplies.
14:00-14:15	AC861	A Feedback-Based Active Power Decoupling Control Strategy for Virtual Synchronous Generators *Hanchi Zhong, College of Electrical Engineering, Sichuan University, China* Abstract-Virtual Synchronous Generator (VSG) control technology is an effective way to provide inertia support for inverter-based resources, whereas the VSG also faces the issue of low-frequency oscillation (LFO) like that in synchronous generators. Especially when applied in low-voltage grids, where the line impedance exhibits the resistance-inductance characteristics, and the power coupling can exacerbate the LFO. At this point, the power coupling problem cannot be ignored. In order to solve this issue, a power decoupling control strategy is proposed to eliminate the adverse influence of the reactive power control loop on the active power control loop, thereby suppressing the LFO deteriorated by power coupling. The effectiveness of this method is validated through the simulation results.

14:15-14:30	AC875	Thermal analysis and heat dissipation optimization of a marine electromagnetic emission principle prototype *Jinyu Zhang, College of instrumentation & Electrical Engineering, Jilin University, China* Abstract-In order to reduce the working temperature inside the underwater compartment of the marine electromagnetic launching system, to ensure the stable work of the high-power power electronic devices in the launching circuit, and to enhance the reliability of the marine electromagnetic detection system in the fields of exploring the seabed geological structure, searching for the seabed mineral resources, monitoring the seabed environmental changes, and assisting the seabed construction project, etc., this paper carries out the power calculation through the actual technical indexes, and establishes an equivalent thermal resistance model. The thermal resistance method is used for analysis; the three-dimensional transmitter model is established by COMSOL software and finite element analysis is carried out to get the heat dissipation of the power electronic devices, and then the forced air-cooled heat dissipation scheme is designed and simulated to optimize the working heat generation of the transmitter. This method can be applied to engineering practice, can effectively simulate the heat generation of high-power devices, and carry out targeted heat dissipation design, so as to improve the thermal stability of the marine electromagnetic detection system, to ensure the long-term stable operation of the system. This work was supported by the Lin Jun Academician Research Workstation of Zhanjiang Bay Laboratory's scientific research project ""Key Technologies Research for Marine Seismic-Electromagnetic Integrated Exploration System.""(ZJW-2022-08-10)
14:30-14:45	AC884	Modeling and Suppression of Common-Mode Electromagnetic Interference in GaN-Based LLC Converter *Dongxu Yu, University of Electronic Science and Technology of China, China* Abstract-Gallium Nitride (GaN HEMTs) are widely used in high-speed switching power supplies. Due to their heightened sensitivity in comparison to Silicon and Silicon Carbide (SiC) devices, GaN HEMTs produce significant dv/dt and di/dt during switching transients, which interact with the parasitic inductance and capacitance in the circuit, consequently causing substantial electromagnetic interference (EMI) issues. An immediate necessity arises for the development of modeling and suppression technique in power electronics. This paper analyzes CM EMI of GaN-based full-bridge LLC converter, and also derive its CM EMI circuit model. Finally, the feasibility of the proposed suppression method is experimentally verified.
14:45-15:00	AC8001	Power system operation simulation considering frequency security with coordination of day-ahead unit commitment and intra-day optimal operation *Chengpeng Zhang, Key Laboratory of Control of Power Transmission and Conversion, Ministry of Education Shanghai Jiao Tong University, China* Abstract-As a large number of synchronous units are replaced by low inertia new energy sources, the frequency security of power system is facing severe challenges. Power system operation simulation of multi-type generators needs to consider frequency security constraints, and faces the problem of day-ahead and intra-day coordination. In this paper, a power system operation simulation method considering frequency security with coordination of day-ahead unit commitment and intra-day optimal operation is proposed. This method constructs a frequency response model of power system containing hydropower, thermal power, wind, solar, nuclear, storage and UHVDC. The frequency security constraints are obtained by Simulink simulation. The day-ahead unit commitment model takes the day-ahead wind-solar-hydropower prediction scenarios as the boundary, and takes the minimum start-up and operation cost of multi-type generators as the objective. The intra-day optimal operation model takes the minimum operation cost of multi-type generators as the objective under the intra-day wind-solar-hydropower prediction. When the frequency security is not satisfied, the frequency security cut constraint is returned and re-solved. Finally, through the IEEE24 node test system, it is verified that the method can ensure that the minimum frequency of the system under high power disturbance is not exceeded under the premise of economy, and ensure the frequency safety of the system.

15:00-15:15	AC873	Multi-objective operation of PV-ESU powered EV charging station *Nedim Tutkun, Istanbul Ticaret University, Turkey* Abstract-Recently electric vehicles (EVs) have been popular choice in many countries due to low carbon emission and less operation cost. The rapid increase in EVs inevitably increases the number of charging stations used to charge them, and this naturally leads to more power demand at certain times of the day. It is also apparent that the increase in energy demand leads to an increase in electricity prices, as well as an increase in power loss in transmission lines. This may reduce the current aura of EVs, as higher electricity prices mean more expensive charging costs. Therefore, creating more competitive conditions at existing charging stations for lower charging costs is essential for a sustainable future. In this study, the primary objective is to reduce the charging cost by integrating a 20-kWp photovoltaic (PV) array and a 20-kWh energy storage unit (ESU) into an existing charging station fed from the grid and considering the overload of the grid and user charging preference. This multi-objective problem is solved for optimal daily cost using the binari-coded genetic algorithm (BCGA). The results show that proposed optimization model worked well, and the charging cost decreased depending on user preferences.

ORAL SESSION 3

Sunday, July 21, 2024 16:00-17:30	Sentosa Island 圣淘沙岛 4F

Oral Session 3: Electrical Faults and Power Load Prediction

Chairperson: Dr. Qirui Li, University of Electronic Science and Technology of China, China

16:00-16:15	AC865	Research on Multi Feature Load Forecasting Method Based on Hybrid Convolutional Neural Network *Jingyuan Cao, North China Electric Power University, China* Abstract-This paper proposes a short-term power load forecasting method based on hybrid convolutional neural networks to address the challenges of accuracy, stability, and adaptability to environmental factors in load forecasting tasks. A multi-scale feature fusion method based on 1D-CNN was proposed, which captures the trend of load changes by fusing features of different scales, improving the recognition ability of load mutations and complex patterns; A multi-feature factor learning method based on 2D-CNN was designed to address the impact of various environmental characteristic factors on electricity loads, which improved the modeling ability of the model for complex relationships between environmental factors and loads; A hybrid network model was constructed to achieve a comprehensive load forecasting method that effectively associates spatiotemporal features through deep feature fusion and information propagation of 1D-CNN and 2D-CNN feature information. Specific case studies were conducted to analyze the impact of parameter optimization and fusion learning on model accuracy and efficiency, and compared with classical models. The results showed that the RMSE value of our model was 36.3, MAE value was 5.34, and MAPE value was 1.02%, effectively improving the accuracy and robustness of load forecasting.
16:15-16:30	AC803	Multi-step Short-term Load Forecasting Based on Attention Mechanism, TCN-BiLSTM Network and Decomposition-based Error Correction *Yawen Yi, Huazhong University of Science and Technology, China* Abstract-Aiming at the problems of regional-level power load forecasting accuracy and efficiency, this paper proposes a multistep short-term load forecasting model based on attention mechanism, TCN-BiLSTM network and decomposition-based error correction. Firstly, improve the combined prediction model TCNBiLSTM with the attention mechanism to improve the model's ability to focus on important information in the input, and a new model structure, Attention-TCN-BiLSTM, is established. Secondly, obtain the preliminary load prediction results based on the Attention-TCN-BiLSTM model. Thirdly, calculate the difference between predicted and actual load sequence to obtain the error sequence. Then, Variational Mode Decomposition (VMD) is applied to decompose the error sequence into multiple subsequences, where the initial number of subsequences is selected through the central frequency method. Fourthly, predict the future values of each subsequence, and superimpose them to obtain the summed error prediction sequence. Finally, sum up the preliminary load prediction results and error prediction results to obtain the final power load prediction results. Example analysis show that attention mechanism combined with error correction significantly improved the prediction ability of TCNBiLSTM Network, and the proposed model outperformed all related models, with the highest accuracy, good robustness and high applicability.

16:30-16:45	AC818	A load forecasting method for charging stations based on K-means Clustering and Markov chain *Liu Yang, Chongqing University of Posts and Telecommunications, China* Abstract-The charging behavior of electric vehicles has a significant impact on the load time distribution of charging stations, which is directly related to the scheduling of the power grid and energy quality. In order to address the transportation and development trends of electric vehicles in mountainous cities in southwestern China, this study proposes a novel charging station load forecasting method that combines K-means clustering and Markov chain technology. Through verification on the MATLAB platform, we conducted detailed simulations of charging loads at different time periods and comprehensively compared the results with the data of the Monte Carlo model. It is gratifying that our model has demonstrated relatively stable charging load prediction ability, providing a reliable basis for practical applications. This research achievement is of great significance for the planning, resource optimization, operation management, power grid balance, and user experience of charging stations, and helps to improve the efficiency and reliability of charging equipment.
16:45-17:00	AC918	Industrial Flexible Load Scheduling Optimization Method Based on Probabilistic Demand Response Potential Evaluation *Peiyu LIU, Huazhong University of Science and Technology, China* Abstract-With the increasing penetration rate of new energy, the reliability and flexible operation ability of new power system are limited, and the application of demand response technology can effectively solve the contradiction of insufficient peak regulation of power grid. In order to solve the problem of how industrial flexible loads participate in system scheduling, this paper proposes an optimization method of industrial flexible coincidence scheduling based on probabilistic demand response potential assessment, and analyzes the typical industrial loads. Firstly, the basic idea of iterative adaptive clustering algorithm is introduced, and an improved fuzzy C-means clustering algorithm based on adaptive clustering center selection is proposed to generate typical daily load scenarios. Then, the load production characteristics of typical continuous and non-continuous production industries are studied, and their adjustable potential is analyzed. Secondly, the demand response potential evaluation method is established for two types of demand response types: peak cutting and valley filling. Finally, with the aim of minimizing the comprehensive operation cost of power system, the optimal scheduling model of industrial flexible load based on probabilistic demand response potential evaluation is established. Numerical results show that the proposed method is effective and reasonable.
17:00-17:15	AC825	Gradient Characteristics of Fault Impedance in Distribution Network of Vegetation High-Impedance Fault *Rui Tang, College of Electrical Engineering, Sichuan University, China* Abstract-Vegetation high-impedance faults in medium voltage distribution networks pose risks to forest fires and cause serious safety accidents. Therefore, it is particularly crucial to develop an effective detection method. The existing methods overlook the non-linear characteristics of the tree impedance, thus, this study establishes a branch circuit model from the perspective of fault impedance based on the physical process of vegetation high-impedance fault. This study finds the majority of trees exhibit a similar process when subjected to the high-voltage conductor. Subsequently, a bi-exponential model based on the early research to accurately capture the initial fault impedance is proposed. The proposed model can better respond to the initial tree impedance gradient decay process, which offers a promising direction for the detection of the vegetation high-impedance fault.

17:15-17:30	AC868-A	Incorporating aging failures in power system reliability tracing *Wei Huang, Chongqing Unversity, China* Abstract-Reliability tracing of the bulk power system has many applications and plays a crucial role in power system operation, investment, and maintenance. In this work, a novel power system reliability tracing approach that considers component aging failures is established. Firstly, the concept of the system's reliable operation boundary is introduced and used for the rapid analysis and quantification of the system's load-loss-risk (LLR), considering factors such as component aging failures and load uncertainty. Subsequently, the method for constructing the reliable operation boundary of the power system that considers component aging failures is proposed, along with an analytical method for calculating the LLR indice. On this basis, an LLR indice apportionment criterion that considers component failure modes and risk responsibilities is introduced to realize the traceability of system risk. Case studies demonstrate the ability of the proposed approach to accurately identify the weak aging components that significantly contribute to the system's unreliability.

ORAL SESSION 4

Sunday, July 21, 2024 16:00-17:30	Kedah 吉打 4F

Oral Session 4: Modern Integrated Energy System

Chairperson: Prof. Haiqing Zhang, Chengdu University of Information Technology, China

16:00-16:15	AC856	Photovoltaic power impact analysis based on nonlinear correlation and time series model *Haiqing Zhang, Chengdu University of Information Technology, China* Abstract-The output power of photovoltaic power generation is a multi-variable and coupled nonlinear random process. Traditional correlation analysis methods are ineffective in detecting the nonlinear relationship between photovoltaic power generation and its related influencing factors. To solve this problem, a nonlinear correlation analysis algorithm is proposed based on shrinking and extending the time window of the Chatterjee correlation coefficient. The time window shrinking strategy utilizes time encapsulation windows to partition the entire time series into several subsequences. It then progressively validates the time window pairs within these subsequences. The time window extending strategy selects pairs of time series that meet nonlinear correlation relationships by traversing the minimum window and expanding to the left and right areas. Experimental results show that the proposed algorithm outperforms existing methods in terms of precision, recall, F-Score, and running time. At the same time, the analysis of Anhui Shijiahu photovoltaic power station shows that the proposed algorithm can analyze nonlinear relationships more accurately than existing methods.
16:15-16:30	AC805-A	Enhancing CuO Photocathodes for Efficient Solar-Driven Photoelectrochemical Water Splitting: An Organic-Inorganic PEDOT:PSS/CuO/MoS2 Approach *Meng Nan Chong, Monash University Malaysia, Malaysia* Abstract-Solar-driven photoelectrochemical (PEC) water splitting stands out as a promising method for green hydrogen (H2) production due to its cleanliness and sustainable nature. The design and development of efficient photoelectrodes are crucial to driving technological advancements in this field. In recent years, cupric oxide (CuO) has gained attention as a potential photocathode material owing to its favourable characteristics, including cost-effectiveness, earth-abundance, low toxicity and narrow band gap. However, technical drawbacks, such as sluggish charge separation, slow interfacial charge transport and rapid charge recombination limit the use of CuO-based photocathodes in PEC applications. In view of these challenges, this work presents a comprehensive strategy to address the limitations of pristine CuO photocathode by incorporating organic p-type PEDOT:PSS thin film as the underlying layer and n-type MoS2 flakes as surface co-catalysts. The well-defined organic-inorganic interface between PEDOT:PSS and CuO facilitates the effective transport of photogenerated holes towards the substrate/PEDOT:PSS junction, while the surface MoS2 flakes form a p-n junction with CuO that accelerates the transfer of photogenerated electrons towards the photocathode/electrolyte interface for H2 evolution reaction (HER). The interactions of these components synergistically lead to improved charge separation, rapid interfacial charge transport kinetics and inhibited electron-hole recombination in the resultant PEDOT:PSS/CuO/MoS2 photocathode. This novel photocathode achieved an enhanced photocurrent density of -2.26 mA/cm2 at -0.6 V vs Ag/AgCl, representing a 2.1-fold improvement compared to the bare CuO photocathode. Electrochemical impedance spectroscopy (EIS) also further confirmed its enhanced PEC water splitting performance and HER kinetics. This study demonstrates a rational approach to overcoming the technical challenges of CuO-based photocathodes, paving the way for efficient and sustainable solar-driven green H2 production.

16:30-16:45	AC801	Research on the Development of a Low Cost Remote Monitoring System for Energy or Environmental Monitoring *Richard Blanchard, Loughborough University, UK* Abstract-Environmental monitoring is essential to help us understand global or local environmental systems especially as human activity is impacting on the viability of sustainable future ecosystems. There are different research philosophies that can be undertaken to establish what exists in the environment and whether it changes over time, for example field surveys or satellite remote sensing. However, both are costly in personnel or technology. Where long term studies are required, remote monitoring can be advantageous as data can be collected without the need for the researcher to be present. But has the disadvantage that data from a remote monitoring device will still need to be physically collected. This paper presents research on the development of a remote monitoring and data-logging system for energy and environmental applications. This device uses sensors to monitor voltage, current and temperature for off-grid energy systems, air and soil temperature, air humidity, soil moisture and photosynthetically active radiation for environmental monitoring. The device stores the data and sends it to a cloud-based store, either using General Packet Radio Service (GPRS) or Wi-Fi. The system can be installed where there is GPRS or Wi-Fi reception and monitored from anywhere with an internet connection. The data is presented in interactive graphs, maps and tables via an Internet of Things (IoT) web dashboard.
16:45-17:00	AC849	A study on the two-part transmission pricing method taking into account the economic differences between provinces *Luyuan Zhang, North China Electric Power University, China* Abstract-With the strengthening of inter-provincial electricity market transactions at the provincial level and above and few blockages in inter-provincial transmission lines, it is easy to observe the phenomenon of flattening of nodal electricity price based on provinces. This situation tends to favor provinces with higher economic levels, which is unfair to provinces with lower economic levels. Therefore, it is necessary to maintain a certain price difference in electricity transactions between provinces. Addressing this issue, this paper proposes a two-part transmission pricing method that takes into account inter-provincial economic differences. Firstly, the roles of energy price and capacity price in the two-part pricing mechanism are analyzed, suggesting that the two-part pricing mechanism should be adopted as the basic structure for regional transmission pricing. Secondly, considering factors such as economic disparities between provinces, transmission costs, and regional grid electricity consumption, the paper proposes using energy price to reflect the marginal change in transmission energy cost within the regional grid and capacity price to reflect the economic disparities between provinces. The paper determines the range of values for energy and capacity price for inter-provincial transmission pricing, based on which a transmission pricing method aimed at minimizing the purchasing costs of all users within the regional grid is proposed. Finally, taking a certain regional grid as an example, the correctness and rationality of the model constructed are validated.
17:00-17:15	AC855	A stacking ensemble model based on nonlinear feature selection for photovoltaic power prediction *Xin Tang, Chengdu University of Information Technology, China* Abstract-With the continuous expansion of photovoltaic (PV) power generation, the safe and intelligent operation of the grid system faces major challenges. Accurate PV power prediction can provide guarantee for grid-connected operation and dispatching plan of PV stations. But PV power is affected by a variety of factors and becomes difficult to predict. In this study, firstly, maximum information coefficient (MIC) and light gradient boosting machine (LightGBM) are used for nonlinear feature selection to obtain the optimal feature subset. Then extreme gradient boost (XGBoost), LightGBM and long short-term memory (LSTM) are used as base models to propose a stacking ensembel model (MIC-XLL) for PV power prediction. Experimental results on two PV datasets show that the proposed model is the best in several evaluation metrics compared with other models.

17:15-17:30	AC832	A Method for Medium Voltage Underground Cables Incipient fault Detection and Location Using Sudden Change of Sheath Current *Hengzhi Ye, College of Electrical Engineering, Sichuan University, China* Abstract-The medium voltage underground cable incipient fault has the characteristics of small fault current with short duration, which is difficult to identify effectively. The detection and location of incipient faults of medium voltage cables can timely find the local defects of cables, and timely replace the cables that may have permanent faults, so as to avoid the impact of permanent faults on the power grid.However, the sheath current of underground cable is very large when incipient fault occur, because the sheath current is almost zero under normal operating conditions. This paper uses this feature to identify the incipient fault of medium voltage three core cable in the case of small resistance grounding system through the sudden change of the sheath current, and realizes the fault section location of the incipient fault through the peak value of the sheath current.Compared with the traditional methods, the method proposed in this paper has the advantages of no additional cable parameters or conditions, less interference from other disturbances and noise, simple measurement, and no additional measurement equipment. The feasibility of the method is verified by simulation. The cable length and system parameters have little effect on the proposed method.

POSTER SESSION 1

Sunday, July 21, 2024 13:30-15:35	Wangjiang Hall Building 望江会馆 4F

Poster Session 1: Intelligent Power Control System Model, Reliability Analysis and Safety Evaluation

Chairperson: Assoc. Prof. Shuheng Chen, University of Electronic Science and Technology of China, China

Poster No.	Paper ID	Paper Title/Presenter
#1	AC872	Steady State Analysis and Simulation of Phase-shifting Full Bridge Series Resonant Converter *Zhiyuan Weng, School of electrical and Optoelectronic Engineering, West Anhui University Lu-an, China* Abstract-The topology structure of phase-shifting full bridge series resonance (PSFB-SRC) is introduced in this paper. In order to obtain a more accurate converter model, a steady-state analysis method based on Laplace's theorem (LBT) is used to deeply analyze the SRC with variable phase-shifting angle. The models and analytical solutions of steady-state differential equations for different operating modes of resonant circuits were provided, and the expressions of important parameters of PSFB-SRC were obtained. The correctness of the PSFB-SRC model analysis results was verified through simulation.
#2	AC834	Research on GIS isolation switch position recognition system based on image processing *Dongliang Ma, Pinggao Group Co., Ltd, China* Abstract-The opening and closing state of GIS isolation switch contact is an important parameter in GIS operating state. Aiming at the problems of dark GIS light and easy reflection of metal moving contact, this paper designs a GIS isolation switch opening and closing state recognition system based on image processing. The system includes image acquisition module, acquisition board and backend online monitoring system, which can collect high quality images of GIS isolation switch and judge its opening and closing state in real time. In addition, this paper proposes a GIS isolation switch on and off state recognition algorithm based on the largest connected component, which is verified on the 252kV smart GIS prototype. The results show that the system designed in this paper has strong robustness, and the recognition accuracy of the switch opening and closing can reach 80.56%.
#3	AC844	A Data-Driven Short-Term Line Loss Forecast Strategy Based on Multi-Head Autoformer Model *Lianfang Xie, State Grid Sichuan Electric Power Company, China* Abstract-Line loss rate prediction is vital for efficient power distribution system management. With advancements in computer and artificial intelligence technologies, new methods for line loss prediction have emerged, however traditional data-driven methods like long short term memory (LSTM), autoregressive integrated moving average (ARIMA), and convolutional neural network (CNN) may not adequately represent real-world conditions due to idealized calculation conditions and data accuracy challenges. This paper introduces the Multi-head Autoformer algorithm, an enhancement of the classical Autoformer model for line loss rate prediction. Multi-head Autoformer algorithm exhibits superior performance in capturing intricate patterns and dependencies within line loss rate data than conventional strategies. Through real-world data analysis, this study demonstrates the effectiveness of the proposed method in accurately predicting line loss rates, addressing the challenges associated with power distribution system management.

#4	AC813	Research on the VIC-Induced resonance of the grid-following PMSG-based wind-driven system *Yizhuo Ma, Shanghai Jiao Tong University, China* Abstract-Most PMSG-based wind systems currently employ grid-following control, relying on a phase-locked loop (PLL) for grid connection. However, it leads to a lack of inertia support in the system. To address this, virtual inertia control (VIC) is crucial for improvement, yet it introduces potential instability due to torsional oscillation interaction with PLL and low-frequency oscillations, an underexplored area. This paper presents a comprehensive analysis of the grid-connected PMSG-based wind farm (WF) system. Comprehensive modal analysis is conducted to analyze the effect of VIC parameters, shaft inertia time constant, and PLL parameters on the interaction of QET oscillations in typical control scenario. The occurrence of interaction and mode conversion is observed when the oscillation frequency and root loci of the torsional, PLL, and low-frequency oscillations are close. Finally, theoretical analysis is validated via SIMULINK simulation verification. These findings offer valuable guidance for industrial grid-following PMSG applications, considering VIC.
#5	AC830	A Method to Assess Shield Corrosion Sizes in Cable Defects Detection Based on Time-frequency Domain Reflectometry *Kun Zhao, Xi'an Jiaotong University, China; Politecnico di Torino, Italy* Abstract-Shield corrosion defects threaten the integrity of power cables. Therefore, the detection and accurate sizing assessment of these defects is crucial. However, existing methods generally fail to precisely evaluate the size of corrosion defects. To address this issue, we propose an approach that integrates Time Frequency Domain Reflectometry (TFDR) with neural network algorithms to detect and size shield corrosion defects. Models of both intact and corroded cable shields are established, with reflected TFDR signals computed subsequently. A four-layer neural network is employed and trained by the data from these signals and achieves sizes assessment of shield corrosion defects. A simulation verifies the performance of the network whose correlation coefficient is over 0.999. An experiment is carried out and the results show that the maximum errors for estimating the angles and lengths of corrosion defects are limited to 5.88% and 13.43%, respectively. This hybrid TFDRneural network methodology demonstrates substantial potential in enhancing power cable maintenance strategies, marking a significant advancement in the operational management of power systems.
#6	AC840	Transient voltage model of PMSG based on phase-locked loop linearization *HongBo Luo, China ELECTRICAL Power Research Institute, China* Abstract-With the rapid development of the new power system and the large-scale integration of new energy units, the grid strength in the areas with high concentration of new energy is gradually weakening, making the transient characteristics of the power system more complex. In order to control operational risks, it is necessary to conduct research on transient voltage analysis models for the integration of new energy units into weak grid systems. This paper establishes an analytical model of the transient machine-side voltage of a PMSG after a grid voltage mutation, and conducts separate tests for short-circuit faults and short-circuit fault clearing to verify the accuracy of the PMSG transient machine-side voltage analysis model. It is also observed that in weak grids, PMSG is prone to transient overvoltage issues after clearing a short-circuit fault. Additionally, in response to the nonlinearity of the trigonometric function of the phase-locked loop during the transient process, a modelling-method for linearizing the phase-locked loop is proposed and it is validated that the established linearized model is suitable for transient voltage analysis, laying a model foundation for studying the mechanism of transient overvoltage generation and formulating relevant strategies for transient overvoltage suppression in the future.

#7	AC862	Research on High Frequency Induced Current Based High Voltage Circuit Breaker Opening and Closing Time Testing Method *Genghao Liu, Hefei University of Technology, China* Abstract-High voltage circuit breaker in the power system plays an important role in the control and protection, high voltage circuit breaker opening and closing time accurate measurement can not only test the performance status of the circuit breaker, but also affects the safe operation of the power system. In order to meet the needs of on-site safety maintenance of high voltage circuit breakers and the accurate testing of breaking and closing times, this paper proposes a method of testing the breaking and closing times of high voltage circuit breakers based on induced currents under the condition of grounding both ends of high voltage circuit breakers, which indirectly analyses the breaking and closing times obtained by the coupled high frequency induced currents. Firstly, the circuit breaker through-fluid circuit is built, and an induced current of fixed frequency is injected into the circuit, secondly, the timefrequency conversion of the circuit current signal is extracted and analysed by using HHT (Hilbert-Huang Transform), and the breaking and closing time is obtained, and finally, the method is verified in the field of the substation, and the test results show that the method is reliable. The results of the study can provide a reference for the new maintenance technology of high voltage circuit breaker.
#8	AC863	Research on the Mechanical Characteristics of High Voltage Circuit Breaker Opening and Closing Based on Machine Vision Technology *Jiajun Li, Hefei University of Technology, China* Abstract-High voltage circuit breaker is the key control and protection equipment in the power system, the closing speed characteristic is an important characteristic parameter of high voltage circuit breaker, the size of which directly affects the working performance of high voltage circuit breaker, and is of great significance to ensure the safe and stable operation of the system. At present, the maintenance personnel through the high-voltage circuit breaker movement linkage or the arm of the sensor installed on the circuit breaker breaking speed characteristics, although the method can achieve the effect of the detection of the speed characteristics of the breaking speed, but the sensor is not installed properly not only affects the results of the measurements, but also may be the movement of the linkage to cause damage; and the circuit breaker type is numerous, the sensor type is also more, maintenance personnel also need to be skilled at. occupy more resources. This paper proposes a speed characteristic analysis method based on machine vision technology, using non-contact measurement means, to achieve high precision and fast analysis of the opening and closing speed. Firstly, a checkerboard grid is pasted on the actuator of high-voltage circuit breaker, and a high-speed camera is used to collect the motion trajectory of the actuator; then, the corner points on the checkerboard grid are detected by using the Shi-Tomasi corner detection algorithm; finally, the motion trajectory of the detected corner points is tracked based on the improved KLT(Kanade-Lucas-Tomasi) optical flow method, and the opening and closing speed characteristics of the high-voltage circuit breaker are obtained. This research method is simple, accurate and applicable to many types of circuit breakers, and it can provide a certain research basis and reference value for the intelligent and efficient maintenance of electrical equipment in the national power grid. This paper is supported by the Science and Technology Project of State Grid Chongqing Electric Power Company, Project No. 52202323001A. .
#9	AC883	Study on Automatic Planning Method of Substation Incoming and Outgoing Line Channels Based on Building Group Analysis *KeYang Sun, Powerchina Sichuan Electric Power Engineering Co., LTD. Chengdu, China* Abstract-The planning of incoming and outgoing line channel stands as a pivotal aspect of substation design. Typically, designers rely on experience and on-site surveys for design, resulting in low work efficiency and difficulty in ensuring the quality of the solutions. To address this issue, this paper considers the influence of building group and proposes an automated method for substation incoming and outgoing line channel planning based on building group analysis. By utilizing grid-based identification of building grids and establishing adjacency operators, this method identifies building group as the basis for automated planning. It further a cyclic alternating algorithm was proposed for selection and verification, facilitating the automated planning of line channel. Experimental results demonstrate the

		effectiveness of this method in ensuring the validity of substation incoming and outgoing line channel planning schemes. Additionally, building group identification based on adjacency operators enables rapid and accurate identification of building group.
#10	AC912	Adaptive Parameters Optimization Method for Photovoltaic Simulation System Based on Multi-layer Recurrent Learning and Genetic Algorithm *Jiaojiao Wang, Maoming Power Supply Bureau of Guangdong Power Grid Co., Ltd. Maoming, China* Abstract-In recent years, large-scale construction of photovoltaic (PV) power stations has been underway, and with different construction requirements, there are more and more PV power stations of different capacity levels. The research on power stations of different levels requires frequent manual changes of system parameters, which is low in efficiency and difficult to find the optimal one. Therefore, this paper proposes an adaptive parameters optimization method for PV simulation system based on the Multi-layer Recurrent Learning and Genetic Algorithm. Firstly, the circuit parameters of the PV system are calculated based on the principle of constant input impedance. Then, the optimization task is designed based on the Multi-layer Recurrent Learning, and finally, the improved Genetic Algorithm is used to optimize the parameters of control system. The experiment results show that the method proposed in this paper can effectively realize the adaptive optimization of PV system parameters and improve the transient and steady state characteristics of the system under various complex operating conditions, providing a reference for the design of other optimization methods, with the characteristics of wide applicability, strong generality and good application prospects.

POSTER SESSION 2

Sunday, July 21, 2024 16:00-17:45	Wangjiang Hall Building 望江会馆 4F

Poster Session 2: Load Forecasting, Optimized Scheduling, and Energy Storage in Presentations: Modern Power Systems

Chairperson: Dr. Chaofeng Yan, University of Electronic Science and Technology of China, China

Poster No.	Paper ID	Paper Title/Presenter
#1	AC848	Optimal Configuration Strategy of Distributed Synchronous Condenser for Large-scale New Energy Sending End System *Guorui Xu, North China Electric Power University, China* Abstract-In the large-scale new energy transmission system, the number of new energy stations and collection station is large, and the power grid structure is complex, the multiple renewable energy station short circuit ratio of each node is lower than the actual operation requirements, in order to improve the short circuit ratio of all new energy stations in the system, the scheme of arranging distributed synchronous condensers(SC) in each station is adopted, which involves two key steps of synchronous condenser location and capacity configuration. On the basis of the multiple renewable energy station short circuit ratio (MRSCR) calculation method, a composite index is derived to characterize the demand degree of the node for the distributed SC, which includes two indexes of the comprehensive compensation demand degree of the node MRSCR and the compensation capacity of the node MRSCR, and the configuration method based on the composite index is designed to optimize the configuration scheme of the distributed SC. Finally, in the PSD-BPA simulation software, the actual synchronous condenser optimization configuration is carried out by using the high proportion new energy sending end system, and the effectiveness of the SC optimal configuration method based on composite indicators has been verified.
#2	AC866	Efficiency Optimization Control of The Proton Exchange Membrane Fuel Cell System Under Variable Altitude Condition *Yu Liu, Dongfang Electric (Chengdu) Hydrogen Technology Co., Ltd., China* Abstract-In order to solve the problem of inefficient operation of Proton Exchange Membrane Fuel Cell (PEMFC) caused by low pressure and low oxygen environment at high altitudes, an efficiency optimization control method (EOCM) for PEMFC system based on variable altitude optimal oxygen excess ratio (OER) was proposed. By testing the optimal efficiency characteristics of PEMFC system models in various high-altitude environments on the RT-LAB semi-physical platform, the optimal OER trajectory under variable altitude environment was obtained to realize the high efficiency region division of PEMFC system. Based on the results of high-efficiency regional division, the sliding mode control based on super-twisting algorithm was adopted to realize the optimal control of PEMFC system. Test verification was carried out on the RT-LAB semi-physical platform, and the results showed that the EOCM method proposed in this paper can keep the high efficiency operation of PEMFC system under the condition of variable altitude. In addition, under different working conditions, EOCM method can still improve the efficiency of PEMFC system, quickly track the optimal peroxide ratio, reduce the overshoot and dynamic response time, and achieve good control effect to ensure the efficient operation of PEMFC system.

#3	AC879	YOLO-WTDL: A Lightweight Wind Turbine Blades Defect Detection Model Based on YOLOv8 *Haohang Sun, Pinggao Group Co., Ltd, China* Abstract-Wind turbine blades are important part of wind power equipment, whose health is very vital for the safe and stable operation of wind power station. However, at present, the defect detection of wind turbine blades requires a lot of computing resources and difficult to ensure the detection accuracy. Therefore, this paper proposed a lightweight wind turbine blades defect detection model based on YOLOv8, named YOLO-WTDL. First, the RFCBAMConv block is introduced to replace the original convolutional blocks in YOLOv8, which enhances the feature extraction capability of YOLO-WTDL. Secondly, the model integrates context anchor attention module with high-level screening feature fusion pyramid module, referred to as CAA-HSFPN, to replace the original feature fusion component in the neck. While reducing the model's complexity, it effectively achieves multi-scale feature fusion and enhances the model's feature expression capability. Finally, the task align dynamic detection head is used to improve the detection accuracy while further reducing the number of parameters, making the model easier to deploy on devices with limited computing resources. The experimental results show that the YOLO-WTDL model is more efficient, accurate and lightweight than the original YOLOv8 model, and has great application value in the field of wind turbine blades defect detection.
#4	AC859	Optimization of capacity allocation for wind-photovoltaic-hydro power generation system based on particle swarm optimization algorithm *Quan Zheng, Pinggao Group Co., Ltd., China* Abstract-Wind-photovoltaic-hydro hybrid power generation is an effective means to increase the power grid's ability to consume wind and solar energy, and the rational allocation of various power source capacities is the prerequisite for its effective application. The optimization model for the capacity allocation of wind-photovoltaic-hydro hybrid power generation systems aims to minimize the annual equivalent investment cost of the system as the objective function, with constraints such as capacity range, loss of power supply probability (LPSP), and power curtailment rate. To address the limitation of traditional particle swarm optimization (PSO) algorithms in tending to get stuck in local optima during model solving, an innovative PSO strategy is designed, which significantly improves the global search ability of the particles. Finally, the optimal ratio of wind and photovoltaic power generation capacities under a typical case system is studied, which verifies the effectiveness of the proposed model and the new algorithm, The impact of different LPSP on the calculation results is analyzed.
#5	AC864	Two-Stage Robust Optimal Scheduling Considering Renewable Power Correlation *Xiangqing Hu, Xi'an Jiaotong University, China* Abstract-The large-scale integrity of renewable energy to the grid makes it greatly difficult to consume because of the randomness and volatility. It is necessary to assess renewable energy consumption capacity so that effective measurements could be taken to adjust and optimize the grid operation mode promptly. An ultra-short-term renewable energy prediction model considering correlation is proposed based on copula function, and then establish a two-stage robust optimal scheduling model, which is solved by column and constraint generation algorithm. The validity of the model is verified in modified IEEE-RTS 1979. The results show that the model can strike a balance between robustness and economy by optimizing flexible consumption zone.

#6	AC871	Power Coordination Control Strategy of Modular Multilevel Energy Router Integrated with Hybrid Energy Storage *Junyi Tang, State Grid Xinjiang Electric Power Co., Ltd. Electric Power Research Institute, China* Abstract-In order to further realize the unified management of dual mode traction power supply system trends and improve the utilization of regenerative braking energy, while taking into account the management of AC negative sequence and DC traction network voltage fluctuations, as well as avoiding the problems of large footprint and high loss in the traditional cascaded H-bridge structure, this paper proposes an MMC based energy router (MER) for dual-current traction power supply system. Firstly, a multi-port topology is designed to realize the energy interaction between AC and DC traction power supply system; then, a coordinated control strategy from central to local is proposed for the objectives of regenerative braking energy recycling and power quality improvement; finally, simulation verifies the correctness and validity of the energy router topology and the control strategy.
#7	AC878	Aggregation model and method considering multi-heterogeneous energy storage for power system scheduling requirements *Yunchao Sun, Tsinghua University, China* Abstract-In order to cope with the high uncertainty of the new power system, diversified energy storage has been developed rapidly in recent years. However, the distributed energy storage equipment also causes difficulties for the optimal scheduling of the power system. In this paper, gravity energy storage and compressed air energy storage, which are more mature in current technology application, are taken as the research objects of new energy storage. Firstly, the operation mechanism of two new energy storage devices, gravity energy storage and compressed air energy storage, is analyzed, and the operation model is simplified appropriately. Then, the VB (virtual battery) model is improved, and a unified energy storage model suitable for polymerization is established to realize the model conversion of electrochemical energy storage, gravity energy storage and compressed air energy storage. Finally, an example is used to prove the effectiveness and accuracy of the aggregation method proposed in this paper, and to verify that compared with the decentralized scheduling of energy storage, energy storage can play a greater role in peak shaving and valley filling in the aggregated state, which provides an effective method and idea for the application of multi-heterogeneous energy storage in new power systems.
#8	AC907	Short-term Load Forecasting using Partial Adversarial Adaptation *Jun Zhou, Chongqing Electric Power College, China* Abstract-Accurate short-term load forecasting (STLF) is vital for modern power systems to be safe and efficient. STLF presents difficulties because of the cyclic, non-stationary, seasonal, and nonlinear nature of electricity consumption. With advanced metering infrastructure (AMI) collecting massive power consumption data, machine learning (ML) methods have emerged as promising tools to improve STLF accuracy. However, one critical challenge faced by existing ML methods is to deal with the domain shift problem when applying ML models into the industrial scenario. To address the limitation, we propose a novel partial adversarial adaptation enhanced deep forecasting (PADF) framework. Specifically, we identify the outlier samples in source domain using a domain classifier without gradient reversal layer (GRL) and reduce the domain shift between normal target and source domain samples at the same time. We demonstrate the effectiveness of PAFF on real-world large-scale datasets from the state grid corporation of China (SGCC).

#9	AC910	Analysis of short-circuit current characteristics of wind farm with MMC-HVDC transmission system under symmetrical fault *Tian Zhang, Chongqing University, China* Abstract-With the development of offshore wind power, wind farm with MMC-HVDC transmission system has received more and more attention. Due to the control effect of power electronics, the short-circuit current characteristics of the sending system are significantly different from those of the traditional power grid. In this article, considering the control strategy of wind farm and the control coupling effect, the short-circuit current characteristics under symmetrical fault at sending system are analyzed in detail. In addition, considering the existence condition of the stable equilibrium point of the system, the current amplitude constraint for the stable operation of the wind farm is derived. Finally, the correctness of current characteristic analysis is verified by time domain simulation.
#10	AC915	Two-layer energy carbon synergy planning for park-level integrated energy system based on dynamic carbon trading model *Haochen Guo, Tianjin University, China* Abstract-The development of low-carbon economy is an important issue facing the modern energy system. As the key to carbon reduction and efficiency increase, PIES has attracted more and more attention. Considering that the dynamic carbon emission factor related to PIES energy consumption is an important factor to improve the carbon trading mechanism, a PIES bi-level programming method based on dynamic carbon trading model and energy-carbon synergy is proposed. Firstly, the energy conversion relationship of each equipment in PIES is modeled. Then, based on the carbon emission flow theory, the CEF relationship model of PIES internal equipment is established to track the carbon footprint of PIES from the source side to the load side, and the dynamic carbon emission factors of the electric, cold and heat load sides are determined. On this basis, a dynamic carbon trading price model with improved CTM mechanism is proposed. Then, based on the constructed dynamic carbon trading model, a two-layer energy carbon collaborative planning method is designed. Finally, the effectiveness of the proposed method in PIES low-carbon economic planning is verified by a typical PIES example.
#11	AC860	Probability Ordered Tree-Based Contingency Screening Method for Power Grids *Hao Wu, Tianjin University, China* Abstract-Contingency screening to generate the expected fault set is important for the power grid reliability evaluation. However, most existing screening methods are not efficient enough, and they may omit some high-frequency contingencies caused by high-order faults, which would impact the accuracy of reliability evaluation. Therefore, based on the probability distance and probability-ordered tree, this paper proposes a novel contingency screening method. The simulation results of RBTS and RTS79 show that, compared with the traditional sorting method, the algorithmic complexity of the proposed method is independent of system size and has higher efficiency.
#12	AC810	The Potential Tapping of Electric Heating in enhancing Power Supply Guarantee Capacity *Zhengjun Bi, Electric Power Research Institute of State Grid Jilin Electric Power Company Limited, China* Abstract-As China proposes to build a new power system with new energy as the main body, the installed capacity of new energy keeps growing at a high speed during the "14th Five-Year Plan" period. The traditional dispatching mode will be difficult to adapt to the high proportion of new energy access. Adjustable resources such as electric heating will strengthen the linkage between sources, networks, and loads, further enhancing the power supply guarantee capacity of the power system. The power supply capability of electric heating load in promoting wind power accommodation needs to be explored. In this paper, the electric heating is reclassified by using big data methods, electric heating power data and wind power data are coupled and analyzed, and the electric heating power forecasting model based on the hybrid decision tree is built. On the basis of verifying the validity of the model, the promoting effect of electric heating on wind power accommodation is analyzed.

ONLINE SESSION 1 (UTC+8)

Sunday, July 21, 2024 14:00-17:35	Room A: 891 3234 0852 https://us02web.zoom.us/j/89132340852

Online Session 1: Modern Power System and Power Transmission Technology

Chairperson: Dr. Jiayi Kong, Beijing Institute of Graphic Communication, China

14:00-14:25	Invited Talk	Implementing Vacuum Insulation Energy Technologies to Buildings for Net-Zero Energy Infrastructure **Prof. Dr. Saim Memon, CEO & Industrial Professor of Renewable Energy Engineering, Department of Industrial R&D in Vacuum Insulation Energy Technologies, Sanyou London Pvt Ltd, UK** Abstract-Vacuum insulation energy technologies such as vacuum insulated wallpaper (VIW), vacuum insulation panel (VIP and decorative integrated VIP are pivotal industrial R&D developments that help in achieving net-zero energy buildings due to their superior thermal efficiency and space-saving attributes. These technologies significantly reduce heat transfer, thereby lowering the energy needed for heating and cooling, aligning with sustainability goals by reducing buildings' carbon footprints. VIW and VIP are particularly effective in extreme climates, offering superior insulation with minimal thickness compared to traditional materials like XPS, EPS, mineral wool, or polyurethane. This results in less space required and lower overall energy consumption. In both cold-arid regions where heating is essential, and hot-arid areas where cooling demands are high, VIPs effectively prevent unwanted heat transfer, enhancing interior comfort while reducing energy use and associated carbon emissions. Overall, the application of VIPs in buildings not only supports stringent building regulations but also contributes to a sustainable, energy-efficient future. This keynote speech focus on addressing global challenges to pave the way for a sustainable, net-zero energy future using vacuum insulation energy technologies.
14:25-14:40	AC880	Measurement and separation of equipment and boundary noise in substations *Zhenghai Liao, China Electric Power Research Institute, China* Abstract-The noise of substation comes from equipment vibration and boundary environment sound, which is mainly concentrated in the low frequency area. To control low frequency noise effectively, it is necessary to identify the noise source accurately and take corresponding measures. Taking Jingmen Substation as an example, this paper measures and analyzes the main transformer, reactor and boundary noise in the substation, and adopts a novel substation noise separation technology based on Conv-Tasnet to separate the substation multi-source noise. It is found that the influence of fan layout on noise control should be considered in the design of transformer cooling system to optimize the overall noise management strategy. For the reactor, the noise of the reactor is mainly propagated to both sides through the open edge, and the noise of the open edge without a firewall is about 10dB larger than that of the closed edge of the firewall. For the boundary, in the same position, the difference between the noise inside and outside the wall is large, because the sound insulation effect of the wall forms a sound shadow area below the wall. Therefore, when there is a sound environment sensitive building outside the wall, the noise measurement of the factory boundary must be based on the top of the wall. Finally, the multi-source separation test of substation noise based on Conv-Tasnet shows that Conv-Tasnet performs well in the separation of multi-source noise, ensuring the consistency of the separated noise and the target noise in the time domain and frequency domain.

14:40-14:55	AC814	Control Approach for Full-Bridge Series Resonant Converter *Jiayi Kong, Beijing Institute of Graphic Communication, China* Abstract-In this article, a full-range output voltage regulation control approach is introduced for full-bridge series resonant converter. Compared with the existing control approaches, the proposed control approach can achieve the full-range output voltage regulation with a limited switching frequency range, zero-voltage switching turn-on for all fully-controlled power switches and zero-current switching turn-off for all power diodes without the auxiliary circuits. Moreover, the operating principle of the full-bridge series resonant converter with the proposed control approach is discussed. The voltage gains and the component stresses of the converter with the different transformer turns ratios are provided with detailed mathematical analysis. Finally, the simulation is employed by the MATLAB/SIMULINK software, which demonstrates the correctness of the theoretical analysis.
14:55-15:10	AC819	Trusted Data Transmission Method Based on Public Key Encryption Against Man-in-the-Middle Attacks in Generation-Grid-Load- Storage Communication *Jiajun Li, Research Institute of State Grid Information & Telecommunication Group Co., Ltd, China* Abstract-The Generation-Grid-Load-Storage achieves the interaction of information and data among various parts such as the generation side, demand side, and dispatch control applications through two-way communication technology. However, it lacks a dedicated security system for the source network load storage network information security, and there is a risk of unauthorized access and illegal tampering of critical data. To enhance the reliability of data transmission, a trusted data transmission method is proposed without introducing third-party hardware devices. This method is based on public key encryption for identity authentication and enhances the ability to resist man in the-middle attacks.
15:10-15:25	AC8003	Research on Development Direction and Key Technology of Modern Smart Distribution Network *Teng Feng, State Grid Economic and Technological Research Institute Co., Ltd. Beijing, China* Abstract-With the continuous deepening of the construction of new energy system, renewable sources and novel loads, such as distributed power supply, electric vehicles and controllable user-side resources, have developed rapidly and their proportion has reached a new height. The fluctuation and randomness of these new sources and loads pose new challenges to the safe operation and flexible regulation of the distribution networks, and it is urgent to upgrade the distribution network towards modernity and intelligence. In response to the requirements of the development of modern smart distribution network, the connotation and characteristics of modern smart distribution networks are analyzed, and the intelligent demand and development focus of distribution network are elaborated. In view of the diversity and difference of distribution network construction, the key technologies for upgrading traditional distribution network to modernity and intelligence are explored by combining five typical scenarios: coordinated development of micro-grid, efficient carrying capacity of charging facilities, efficient utilization of new energy storage, upgrading of urban and rural distribution network, and efficient coordination of source, network, load and storage.

15:25-15:40	AC8009	A Novel Pulse-Injection Electromagnetic Detection Method for Seepage Pathways in Pumped Storage Power Plants *Wei Liu, Chongqing Electric Power Research Institute, State Grid Chongqing Electric Power Co., Chongqing, China* Abstract-Seepage in pumped storage power plants can cause serious structural and operational issues, requiring accurate detection methods. This paper introduces a novel pulse-injection electromagnetic detection method to identify seepage pathways. It involves injecting current pulses into the ground and measuring the primary and secondary electromagnetic field responses, improving sensitivity and accuracy over traditional techniques. First, a detailed analysis of the magnetic field composition at the measurement points is conducted. By selecting appropriate magnetic field observation periods and observation distances, the influence of power wires can be eliminated. The location of the leakage channel can then be identified through the mapping of induced voltage. Simulation and experimental results demonstrated that the method exhibits superior capability in accurately identifying seepage pathways, showing significant engineering application value.
Breaktime: 10min		
15:50-16:05	AC902	Bidirectional Low-Voltage Solid-State Circuit Breaker Based on SiC MOSFET *Daoqi Wang, University of Jinan, China* Abstract-Solid-state circuit breakers have been widely used at home and abroad because of their advantages such as extremely fast breaking speed, no arc, and long service life. However, at present, the application scenarios of solid-state circuit breakers are limited due to their high loss and large volume. Based on the 34mm commercial power semiconductor module, the parameter design method of a compact 270V/100A solid-state circuit breaker and the design of the energy-absorbing branch based on TVS are proposed in this paper. By building an equivalent experimental platform, a 100A load current breaking experiment and a 200A fault current blocking experiment are carried out. Experimental results show that the solid-state circuit breaker proposed in this paper can conduct 100A current for a long time and block 200A fault current in microseconds, proving its feasibility.
16:05-16:20	AC903	Compact Hybrid Transformer Topology and Control Strategy Research *Hongshu Wang, University of Jinan & Institute of Electrical Engineering, Chinese Academy of Sciences, China* Abstract-The high penetration characteristics of Distributed Generation (DG)lead to frequent voltage fluctuations in smart distribution grids, rendering traditional on-load tap-changing transformers (OLTC) unable to effectively and rapidly address voltage fluctuation issues. This paper proposes a Power-Converting Embedded Hybrid Transformer (PCE-HT) that is applied to the low-voltage side and is compact in size, namely by serially connecting a small AC/DC/AC converter module to the secondary side of a conventional three-phase transformer. The power electronics module serially connected to the secondary side can control active and reactive power in real-time through control strategies, promptly output compensating voltage and thereby further stabilize the voltage across the load. Moreover, to better verify the functionality of the AC/DC/AC module. Hardware experimental validation of the AC/DC/AC module was conducted, along with MATLAB simulation validation of the proposed new topology presented in the final part of this paper. The simulation results and hardware experimental outcomes of the power electronics module confirm the effectiveness of the proposed new topology, the functionality of the AC/DC/AC module, and the correctness of the control strategy.

16:20-16:35	AC904	Fault Detection in Weak AC Power Grids with Double-fed Wind Turbines using Hankel-EfficientNet *Tianchi Zhang, Software College, Southeast University, China* Abstract-In the past decade, renewable energy has emerged as a pivotal component of modern power systems. However, fault detection in weak AC power grids, characterized by a high proportion of renewable energy generation, has become increasingly challenging. Addressing this challenge necessitates enhancing the reliability of the power system. This paper presents a fault detection algorithm leveraging the Hankel-EfficientNet approach within a deep learning framework. The methodology involves simulating output data via a simulation model and transforming it into the requisite image dataset using Hankel transformation. Subsequently, the EfficientNet neural network is deployed to train the dataset, and an appropriate loss function is selected for model optimization. Experimental results demonstrate that the average accuracy of the Hankel-EfficientNet network attains 100%, thereby fulfilling fault detection requirements in AC power grids.
16:35-16:50	AC804	A Recap of Modern Power Grid Control Systems *Sinawo Nomandela, Cape Peninsula University of Technology (CPUT), South Africa* Abstract-Wind power plants (WPPs) and photovoltaic power plants (PV systems) are the most popular types of renewable power plants (RPPs) in the formation of modern power grids. A lot of modern power grids have already been interconnected with WPPs. Control methods have been proposed and (or) developed in the existing research. However, it has been found that the existing literature does not clearly state the exact point where these control methods should be applied in the modern power grid. Also, till today, the existing literature does not look at and clearly define the difference between the control methods for the point of connection (POC) and the point of common coupling (PCC). In this article, the control methods applied in modern power grids are discussed, and the linkage between them has been described clearly.
16:50-17:05	AC882	Analysis of Fault Characteristics of AC transmission Line in Offshore Wind Farm *Liuming Jing, North China University of Technology Beijing, China* Abstract-The basic working principle and topology of the offshore wind power transmission system are introduced, and the negative sequence suppression control strategy and low-voltage ride-through control strategy adopted in the offshore converter station in the event of a fault are analyzed. Considering the control strategies of offshore converter stations and offshore wind farms, a fault equivalent sequence network is established for single-phase ground faults and interphase faults to analyze the fault characteristics of AC converging lines, and the simulation results show the correctness of the fault characteristics analysis.
17:05-17:20	AC831	An Automatically-Adjusting-tension and Preventing- fracture Cathode Wire for Electrostatic Precipitator *Jingsong Zeng, Anhui Technical College of Mechanical and Electrical Engineering, China* Abstract-The present document discloses a cathode wire of electrostatic precipitator. The two ends of the cathode wire of the electrostatic precipitator are respectively fixed on the upper beam and the lower beam of the cathode frame. The cathode wire of the electrostatic precipitator includes a cathode rod and a discharge body; Among them, multiple discharge bodies are equipped with through-hole that match the cross-sectional surface of the electrode rod, and the electrode rod runs through the through-hole of the discharge body and is fixed by welding. Moreover, the cathode wire is equipped with spring washer and positioning expansion washer that can automatically adjust its tension with temperature changes to ensure vibration acceleration. The cathode wire of the electrostatic precipitator in this article overcomes the problems of the existing technology that seriously affect the stable operation of the electrostatic precipitator, such as breakage, detachment of the discharge body, looseness and weakness, insufficient tension, and poor effect of vibration and dust cleaning.

17:20-17:35	AC908	Adaptive Intelligent Local Feeder Automation Strategy Based on Hierarchical Protection *Linli ZHANG, State Grid Shandong Electric Power Research Institute, China* Abstract-Aiming at the problems that the traditional feeder automation (FA) needs to reclose multiple times when dealing with permanent faults, the processing speed is slow and it cannot deal with ground faults, an adaptive intelligent local feeder automation strategy is proposed. In this strategy, the sectionalizing switches and tie switches are all replaced with primary and secondary integrated circuit breakers, the function of disconnecting the segment switch when no voltage is detected is cancelled, the X time limit and Y time limit are optimized, and acceleration protection is started when detecting voltage and fault. When voltage is detected and disappears again within a short period of time, the switch is opened and reversely locked. Compared with the original strategy, the proposed method only needs one reclosing operation to complete the fault processing, which significantly decrease the fault processing time and has the ability to deal with both short circuit faults and ground faults. Then the action logic of the adaptive intelligent local feeder automation for short circuit fault and ground fault is given, and the feasibility of the strategy is verified. Finally, the adaptive intelligent local feeder automation strategy proposed in this paper is applied to an actual distribution network, and the practical application effect of the method is analyzed.

ONLINE SESSION 2 (UTC+8)

Sunday, July 21, 2024 14:00-17:35	Room B: 845 1815 9740 https://us02web.zoom.us/j/84518159740

Online Session 2: Optimizing Operation and Market Analysis of Intelligent Power System

Chairperson: Assoc. Prof. Li Li, Beijing Information Science and Technology University, China

14:00-14:25	Invited Talk	Towards Cyber-secure RES-integrated Power Systems: Cyber Risk Analysis and Attack Detection **Asst. Prof. Kaikai Pan, Zhejiang University, China** Abstract-The digital transformation and renewable energy source (RES) integration have introduced a new challenge for robustness: cyber security threats in modern power systems. The cyber incidents against power systems, such as the Stuxnet worm attack and the hacker-caused Ukraine blackout, do illustrate the features of a potent attack that can have extensive resources to corrupt multiple data channels by both integrity and availability, and also the strong capability to keep stealthy from possible detectors. The majority of research has focused on pure data integrity or availability attacks from a specific aspect of vulnerability or impact assessment. However, vulnerability or even cyber risk analysis methods for combined attacks and high-threat attacks emerging from RES integration, are lacking and in need to be developed. This talk introduces the author's research works on cyber risk analysis of RES-integrated power systems to high-threat attacks and robust attack detection approaches.
14:25-14:40	AC812	Design and Simulation of CCS Fuel Cold Energy Liquefaction CO2 System for Large LNG Powered Ships Based on Aspen HYSYS *Gang Zhang, Vocational Training Branch Qingdao Ocean Shipping Mariners College, China* Abstract-Aiming at the problem of high energy consumption in CO2 liquefaction process on a large LNG-powered ship with Carbon Capture and Storage (CCS) device, a system utilizing LNG cold energy for CO2 liquefaction was designed, the system scheme were simulated by Aspen HYSYS. Based on the key node A-1, the optimal value of cold energy utilization of the system and device under 75% working conditions of the ship is determined, and the CO2 liquefaction system using LNG cold energy is calculated according to different working conditions. When the working condition of the ship was 60%, exergy efficiency of the CO2 liquefaction system utilizing LNG cold energy reached the maximum of 57.78%, the utilization rate of LNG cold energy is about 79.69%, so the effective utilization of LNG cold energy could be realized and the energy consumption of the system liquefied CO2 was reduced at the same time.
14:40-14:55	AC816	Research on Bidding Strategies of Pumped Storage Power Station Considering the Risk of Electricity Spot Market *Hongjian Ding, North China Electric Power University, China* Abstract-With the continuous development and improvement of Chinese electricity market, pumped storage power plants will face complex price mechanisms and transaction risks when participating in the electricity spot market. In order to protect the revenue of pumped storage power station, an optimization model of pumped storage bidding strategy considering the risks of the electricity spot market is proposed. Firstly, the price mechanism and transaction risk of pumped storage in electricity market are studied. Secondly, based on the conditional risk value, the risk of participating in the electricity spot market is quantified, and the risk-return matching mechanism is established. Based on electricity price prediction clustering to generate typical electricity price scenarios, a bidding strategy for pumped storage power stations to participate in spot-auxiliary service collaborative market considering risk factors is proposed. Finally, the influence of different risk preference levels and electricity price scenarios on the revenue of pumped storage power station is analyzed with examples. The results of the example show that the bidding strategy can stabilize the income fluctuation in different

		market scenarios and effectively avoid the risk of market price fluctuation. It can provide decision support for the pumped storage power station to participate in the bidding and capacity allocation strategy of the electric energy and auxiliary service market, and make the power station income more stable.
14:55-15:10	AC820	Review of SOH prediction methods for lithium-ion batteries *Antong Xiao, Northeastern University, China* Abstract-Lithium-ion batteries are widely utilized due to their outstanding performance in the energy storage sector, spanning various applications such as smartphones, automobiles, and laptops. As a crucial functionality within Battery Management Systems (BMS), monitoring the State of Health (SOH) of lithium-ion batteries not only enables the BMS to make timely adjustments to extend battery life but also ensures the safe utilization of batteries, preventing potential accidents. Given its significance, numerous researchers conduct extensive studies on predicting battery SOH and propose various methods. This paper collects various methods for predicting the State of Health (SOH) categorizes current SOH prediction methods into three main types: model-based methods, data-based methods, and hybrid methods. Each method is elaborated upon in detail, and the performance differences among them are analyzed. Finally, the paper summarizes the challenges facing current SOH predictions and explores potential research directions for the future.
15:10-15:25	AC821	Research on multi-dimensional comprehensive evaluation system of planning schemes based on source-grid-load-storage operation optimization *Chen Xinyi, Shanghai Jiao Tong University, China* Abstract-High proportion of new energy access will be one of the important directions of future power system development. In order to cope with the uncertainty caused by high proportion of new energy and improve the regulation ability of power system, resource planning should be carried out on each side of source-grid-load-storage. On this basis, for different planning schemes, a comprehensive evaluation system is urgently needed to comprehensively evaluate the planning schemes. Aiming at the economy, environmental protection, flexibility, adequacy and other indicators of power system planning, this paper proposes a multi-dimensional comprehensive rating system for power system. The improved IEEE-24 node system is used to verify the evaluation system.
15:25-15:40	AC809	A study of off grid environment friendly power suppling solution to telecom towers in NEOM *Mazen Alkhrijh, Department of Electrical Engineering, King Saud University, Saudi Arabia* Abstract-This study analyzed an off-grid, environment-friendly power-supplying solution for telecom towers in NEOM. For this purpose, solar with batteries, solar with diesel generator, and diesel generator with batteries are proposed and compared to a typical dual diesel generator. To compare, the Life Cycle Cost (LCC) is calculated as the basis of economic comparison, and CO2 emissions are used as the basis of environmental comparison. The result shows that using a single factor of comparison, such as LCC, the typical dual diesel generator is 0.97M[SAR] and 1,017 tons of CO2 emissions in 10 years. Solar with batteries is the most expensive solution, with 2.47M[SAR] in 10 years but No CO2 emissions. The unit of energy and cost-CO2 emissions show that solar power with diesel generators is better than diesel generators with batteries.
Breaktime: 10min		

15:50-16:05	AC829	Research on Optimal Regulation of Photovoltaic Integrated 5G Base Stations Based on K-means Clustering Algorithm *Xinyang Jiang, Tianjin University, China* Abstract-In recent years, with the massive construction and dense distribution of 5G base stations (BSs), the cost of electricity consumption for communication operators and carbon emissions have surged. Therefore, the configuration of distributed photovoltaics for BSs has become a research focus. However, the high computation complexity of massive 5G BSs regulation seriously affects the solution speed of BSs optimal regulation. For this reason, the research on optimal regulation of photovoltaic integrated 5G BSs based on K-means clustering algorithm is proposed. Firstly, this paper models photovoltaic integrated 5G BSs based on the communication load characteristic of BSs. Furthermore, a clustering strategy for 5G BSs based on K-means algorithm is proposed, and an economic optimization model for photovoltaic integrated 5G BSs is constructed based on the clustering results. Finally, the clustering results of massive photovoltaic integrated 5G BSs are discussed through simulation examples. Simulation results show that the research can fully improve the optimal regulation speed of 5G BSs while ensuring their regulation potential, thereby quickly achieving economic operation of BSs.
16:05-16:20	AC836	Social Impact Management of Power Grid Enterprises Based on the Concept of Creating Shared Value *Wei Li, Chengxian College, Southeast University, China* Abstract-Introduce the concept of creating shared values into the social impact management of power grid companies, identify the social impact of power grid companies from three dimensions of economic impact, social impact, and environmental impact, and classify them according to the nature and the way of the impact, match value co-creation and society impact types, put forward ideas and strategies for social impact management, and finally build a social impact management measurement system for power grid companies.
16:20-16:35	AC877	A Blockchain-based Privacy-Preserving Matching Scheme for Power Data *Zufeng Hou, Zhuhai Power Supply Bureau, Guangdong Power Co., Ltd, china* Abstract-The current mode of power data trading heavily relies on web pages as the conventional mediation method. However, dishonest parties in trading may intentionally resell the dataset of the power grid company, or the grid company may be unable to determine what the buyer has done with the power data, thereby compromising the privacy of power users. Therefore, enhancing efficiency and privacy while ensuring trading security and data reliability is a challenging task in the field of power data trading. To address the issue of whether the power data provided by sellers aligns with the requirements of buyers in power data trading, a blockchain-based supply-demand consistency privacy-preserving matching scheme (BPMS) is proposed. The scheme leverages attribute-based searchable encryption (ABSE) and linear secret sharing scheme-based matching strategy to create a matching environment that adheres to privacy protection requirements, enabling consistent alignment of supply and demand while safeguarding the privacy of power users. Subsequently, by equipping the blockchain-based power data trading platform (BDTP) with public and private keys, it ensures that matching services can only occur within the specified platform. The construction of the blockchain enables the storage of matching information on-chain for future queries and traceability. Furthermore, the BPMS also implements access control on the buyer's data processing tasks. By utilizing LSSS-based ciphertext policy attribute-based encryption (CP-ABE), it allows the seller to decrypt and obtain insights into the processing task taken by the buyer with the power data after successful matching and meeting specific attribute criteria. Finally, the scheme undergoes analysis and performance evaluation, demonstrating its feasibility and superiority.

16:35-16:50	AC923	Study on the method of dividing the proportion of units covered by pumped storage capacity tariffs *Ziyu Ma, North China Electric Power University, China* Abstract-This paper mainly studies the division method of the proportion of units covered by capacity tariff for pumped storage power stations. Firstly, the framework of the two-part tariff mechanism for pumped storage is analyzed, and the influencing factors of the division of the proportion of units covered by the capacity tariff are analyzed from the internal and external factors respectively; secondly, the division of the proportion of units covered by the capacity tariff for pumped storage based on the risk-weighted return is established, and the model of assessing the economic benefits of pumped storage power stations that have gradually entered the market stage is established; finally, the case study of a certain pumped storage plant in Fujian Province is conducted. Finally, a pumped storage power plant in Fujian Province is used as a case study to assess the economic efficiency of the pumped storage power plant, and then the sensitivity analysis is used to study the impact of the proportion of the capacity of the units covered by the approved capacity tariff on the economy of the power plant.
16:50-17:05	AC920	Research on Partial Discharge Detection and Evaluation Method for High Voltage Switchgear Based on AHP-Fuzzy Comprehensive Evaluation *Linze Li, State Grid Beijing Shunyi Power Supply Company, China* Abstract-This paper proposes a partial discharge detection and evaluation method for high voltage switchgear based on the Analytic Hierarchy Process (AHP) and Fuzzy Comprehensive Evaluation. By integrating detection data from three partial discharge detection methods—Transient Earth Voltage (TEV), ultrasound, and Ultra High Frequency (UHF)—the evaluation information for partial discharge in high voltage switchgear is obtained. First, the AHP is used to assign weights to the three detection methods. Next, approximate function relationships for the different partial discharge detection methods are constructed based on a large amount of data. Finally, the data is analyzed using the Fuzzy Comprehensive Evaluation method to obtain the final evaluation results.
17:05-17:20	AC870	Who will adapt faster: insights from studying the underlying impact of climate change perception on people's willingness to adopt household PV-BES system *Beining Chen, Beijing Information Science and Technology University, China* Abstract-By regarding household photovoltaic and battery storage hybrid energy systems (PV-BES) as a typical climate change adaptive product, this study analyzes the impacts of people's climate change and adaptive capacity perception, including climate change perception (CCP), self-coping ability (ABT), social connectedness with friends (SCF) and government trust (GVT), on their willingness to adopt (WTA) PV-BES. The classical Theory of Planned Behavior (TPB) model was extended to establish an explanatory framework. Our structural equation modeling results show that people who have higher SCF tend to take climate change adaptative action faster because they are usually more innovative or feel the action is more controllable. The prior experience of electricity shortages caused by climate change disasters (EESCCD) alters the way people think when they evaluate adaptive behaviors. Specifically, people with EESCCD are more likely to take adaptive actions because of higher CCPs, and invest more mental efforts to evaluate the behavior from practical perspectives, ultimately making decision more rationally.
17:20-17:35	AC823	Analysis on Transformer Protection Maloperation Caused by Single-phase Tripping of Wind Farm Transmission Lines *Yiping Luo, State Grid Sichuan Electric Power Company Electric Power Research Institute, China* Abstract-This paper introduces a case of transformer voltage and overcurrent composite protection maloperation caused by single-phase tripping of a wind farm transmission line. Firstly, the case is briefly introduced as a background. Then, the system operating mechanism and the electrical characteristics after single phase-tripping of the wind farm transmission line are analyzed. Subsequently, the reason for protection maloperation is revealed combined with the principle of transformer voltage and overcurrent composite

		protection. Finally, improvement measures to avoid protection maloperation are proposed. The research results show that the single-phase tripping of the wind farm transmission line will generate high negative voltage and overcurrent, leading to maloperation of the transformer's voltage and overcurrent composite protection. The time delay of the transformer's voltage and overcurrent composite protection should be greater than the single-phase tripping operation time to avoid protection maloperation.

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