Conference Abstract

2021 11th International Conference on Power and Energy Systems (ICPES 2021)

December 18-20, 2021

Virtually

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Welcome Message

Dear experts, researchers, and friends,

Welcome your participation. 2021 11th International Conference on Power and Energy Systems (ICPES 2021) and WIOTE will be held during December 18-20, 2021 in Shanghai, China. It's sponsored by Shanghai Jiao Tong University, University of Electronic Science and Technology of China, and Tongji University. Due to unstable COVID-19 pandemic situation, for all delegates' health consideration, conference is turned to be held virtually. Nevertheless, our whole organizing committee group will work hard to provide you with a high-quality conference as always, and we hope we can get your understanding and support as well.

Share good news with you all: our conference chair Prof. Qi Huang from Chengdu University of Technology, China is elected IEEE Fellow this year for leadership in informatics for smart electric energy system. Congratulations to Prof. Huang!

This year, conference proceedings accepted submissions from research institutions, universities and industries after careful peer review by conference technical program committee. Meanwhile, we are honored to invite 3 excellent keynote speakers joining us, they are: Prof. Chris Mi (Fellow IEEE & SAE) from San Diego State University, USA; Prof. Atsuo Kawamura (IEEE Fellow) from Yokohama National University, Japan; Prof. Udaya Madawala (IEEE Fellow, Distinguished Lecturer of the IEEE Power Electronic Society) from University of Auckland, New Zealand. With the brilliant keynote speeches and inspiring sharing of the authors of those accepted papers, we believe we'll have a fruitful conference. Also we look forward to your survey feedback in continuing to keep this conference a great experience in future years.

For making this conference possible, we would like to express our heartfelt appreciation to all our delegates, keynote speakers, session chairs and committee members who involved in the technical evaluation of conference papers and in the organization of the conference for their time, effort, and great contributions.

Finally, wish conference a great success and wish all of you success in your work and happiness in your life. Look forward to meeting all of you again next year face to face on conference.

Conference Chair of ICPES2021
Haozhong Cheng,
Shanghai Jiao Tong University, China

Test Arrangement and Use Information

Test Arrangement

Date	Arrangement

Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

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Zoom Information

- ZOOM online conference room will be open 30 mins before scheduled time.
- **ZOOM Download: https://zoom.us/**
- **ZOOM Using & Presentation Instruction:** www.icpes.org/PresentationInstruction.pdf
- It's suggested to use headset with microphone or earphone with microphone.
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- Prepare the PPT file of your presentation on your laptop in advance.
- Duration of Each Presentation: 15 Minutes in total including 12 mins Presentation and 3 Minutes Q&A.
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Keynote Speaker

Dec. 18, 2021, Saturday, 9:10-9:55, Beijing Time, GMT+8
Zoom Link: https://zoom.us/j/96203075575 Password：121820

Prof. Chris Mi

IEEE Fellow & SAE Fellow

San Diego State University, USA

Speech Title: Application of wireless power transfer in electric aircraft, railway, ships, and road vehicles

Abstract: Wireless power transfer (WPT) technology offers significant improvement in convenience and safety and has found many applications, such as electric vehicle (EV), implanted medical devices, mobile devises, under water vehicles, industrial automation equipment, robots, and automatic guided vehicles, etc. Both capacitive and inductive wireless power transfer technologies have been investigated for various applications. Experiments have shown that tens or even hundreds of kilowatts of power can be transferred over 200 mm distance with an efficiency of 97% (DC-DC) or more, and an alignment tolerance of up to 300mm.

In this presentation, we will first look at the basic principle of WPT. Then we will show that safety is still one of the major concerns of WPT system for both inductive and capacitive power transfer, especially for high-power applications. Then, we will discuss two unique topologies developed by the research group of Prof. Mi, including the double-sided LCC topology and the LCLC topology for capacitive wireless power transfer. Finally, we will show some case studies that involve electric aircraft, railway, ships, and road vehicles.

Bio: Chris Mi is a fellow of IEEE and SAE, Professor and Chair of the Department of Electrical and Computer Engineering, and the Director of the US DOE-funded GATE Center for Electric Drive Transportation at San Diego State University, San Diego, California, USA. He was previously a professor at the University of Michigan, Dearborn from 2001 to 2015. He received the B.S. and M.S. degrees from Northwestern Polytechnical University, Xi'an, China, and the Ph.D. degree from the University of Toronto, Toronto, Canada, all in electrical engineering. Previously he was an Electrical Engineer with General Electric Canada Inc. He was the President and the Chief Technical Officer of 1Power Solutions, Inc. from 2008 to 2011.

His research interests are in electric and hybrid vehicles. He has taught tutorials and seminars on the subject of HEVs/PHEVs for the Society of Automotive Engineers (SAE), the IEEE, workshops sponsored by the National Science Foundation (NSF), and the National Society of Professional Engineers. He has delivered courses to major automotive OEMs and suppliers, including GM, Ford, Chrysler, Honda, Hyundai, Tyco Electronics, A&D Technology, Johnson Controls, Quantum Technology, Delphi, and the European Ph.D School. He has offered tutorials in many countries, including the U.S., China, Korea, Singapore, Italy, France, and Mexico. He has published more than 300 articles and delivered more than 100 invited talks and keynote speeches and as a panelist in major IEEE and SAE conferences.

Dr. Mi is the recipient of the "Distinguished Teaching Award" and "Distinguished Research Award" of the University of Michigan Dearborn. He is a recipient of the 2007 IEEE Region 4 "Outstanding Engineer Award," "IEEE Southeastern Michigan Section Outstanding Professional Award." and the "SAE Environmental Excellence in Transportation (E2T) Award." He was also a recipient of the National Innovation Award and the Government Special Allowance Award from the China Central Government. He received three Best Paper Awards from IEEE Transactions on Power Electronics and two Power Electronics Prize Letter Awards. In 2019, he received the IEEE Power Electronics Emerging Technology Award.

Dr. Mi was the Chair (2008-2009) and Vice-Chair (2006-2007) of the IEEE Southeastern Michigan Section. Dr. Mi was the General Chair of the 5th IEEE Vehicle Power and Propulsion Conference, Area Editor of IEEE Transactions on Vehicular Technology, associate editor of IEEE Transactions on Power Electronics, Associate Editor of IEEE Transactions on Industry Applications. He is the topic chair for the 2011 IEEE International Future Energy Challenge and the General Chair for the 2013 IEEE International Future Energy Challenge. Dr. Chris Mi is a Distinguished Lecturer (DL) of the IEEE Vehicular Technology Society.

He is Guest Editor-in-Chief of IEEE Journal of Emerging and Selected Topics in Power Electronics - Special Issue on WPT, Guest Co-Editor-in-Chief of IEEE Transactions on Power Electronics Special Issue on WPT, Guest Editor of IEEE Transactions on Industrial Electronics - Special Issue on dynamic wireless power transfer, and steering committee member of the IEEE Transportation Electrification Conference (ITEC- Asian). He is Program Chair or General Chair of a number of international conferences, including Workshop on Wireless Power Transfer (WoW), IEEE International Electric Vehicle Conference (IEVC), and IEEE International Transportation Electrification Conference – Asia-Pacific. He is the Guest Editor of a Special Issue of the Proceedings of the IEEE - Electric and Hybrid Vehicles.

Keynote Speaker

Dec. 18, 2021, Saturday, 9:55-10:40, Beijing Time, GMT+8
Zoom Link: https://zoom.us/j/96203075575 Password：121820

Prof. Atsuo Kawamura

IEEE Fellow

Yokohama National University, Japan

Speech Title: Challenge to Realization of 99.9% Power Conversion Efficiency Inverter and Its Application Fields

Abstract: With the advent of wide-band-gap(WBG) power semiconductor devices, power conversion with high conversion efficiency has become possible, but since the output of DC-AC power conversion (inverter) is AC, it is more difficult to achieve ultra-high efficiency compared to DC-DC conversion.

First, the current status of recent published literature on high efficiency inverters is presented, followed by the latest results of high efficiency HEECS inverters being pursued by the authors' group. With higher efficiency comes the need to guarantee the accuracy of the measurement. Second, speaker’s group have proposed a new loss measurement method called the VTASLM, which uses only electrical measuring instruments, and have measured a conversion efficiency of 99.75% with a measurement accuracy of 0.006%. The measurement method and results are presented. Third, the measurement results of the loss breakdown are presented and the policy on how to obtain higher efficiency is discussed. Finally, the speaker's dream is discussed concerning a future power grid that makes effective use of renewable energies using high-efficiency power converters.

Bio: Atsuo Kawamura (S’77-M’81-SM’96-F’02-LF’2019) received the B.S.E.E., M.S.E.E., and Ph.D. degrees in electrical engineering from the University of Tokyo, Tokyo, Japan, in 1976, 1978, and 1981, respectively.

In 1981, he joined to the Department of Electrical and Computer Engineering, University of Missouri, Columbia as a Postdoctoral Fellow, where he was an Assistant Professor from 1983 to 1986. Since 1986, he has been with the Division of Electrical and Computer Engineering, Yokohama National University, Yokohama, Japan, where he was first an Associate Professor and later became a Professor in 1996. He served as a dean of College of Engineering Science and Graduate School of Engineering from 2013 to 2015. He has become Professor Emeritus in 2019, and now is a professor of endowed chair (Power Electronics) at the same university. He has served to completion of 38 Ph.D and 145 Master’s and 179 Bacheler’s students. He holds 7 patents and has published more than 130 journal papers and 320 international and 560 domestic conference papers, and 9 books.

His research interests include power electronics, digital control, electric vehicles, robotics, train traction control, etc. He received several awards including the IEEE IAS Transactions Prize Paper Award in 1988, the Prize Paper Award of IEE of Japan in 1996, IEEE IES Transactions Best Paper Awards in 2001 and 2002 , and EPE-PEMC Award in 2008. He became a Fellow of the IEEE in 2002 with the citation, "For Contributions to Real-Time Digital Feedback Control of PWM Inverters.”

Dr. Kawamura is a Fellow of the Institute of Electrical Engineers of Japan(IEE of Japan), and member of Robotics Society of Japan. He was the conference chairperson of the IEEE/IAS and IEEJ/IAS joint Power Conversion Conference (PCC-Yokohama) in 1993. He was an associate editor of IEEE Power Electronics Transactions from1995 to 2000. He was the program chair of the 2009 Robotics Society of Japan Annual Meeting, and was the conference Chair of IPEC-Sapporo-ECCE-Asia in 2010 and a president of IEE of Japan/IAS(Industry Application Society) in 2012-2013, and a conference chair of 2018 IEEJ IAS annual meeting (JIASC) at Yokohama.

Keynote Speaker

Dec. 18, 2021, Saturday, 11:00-11:45, Beijing Time, GMT+8

Zoom Link: https://zoom.us/j/96203075575 Password：121820

Prof. Udaya Madawala

IEEE Fellow

Distinguished Lecturer of the IEEE Power Electronic Society

University of Auckland, New Zealand

Speech Title: EV Charging: Technical Challenges

Abstract: Electric vehicles (EVs) reduce air pollution and global warming, and are ideal for sustainable living. However, the high uptake of EVs also poses some technical challenges. These include the demand for increased levels of EV charging infrastructure, demand-side issues associated with charging infrastructure planning and charging services, and grid impacts due to large-scale charging demands that compromise the stable and economic operation of the power grid. Thus, to mitigate grid impacts and overcome demand-side, it is crucial to deploy charging infrastructure strategically and operate charging services properly. This seminar discusses these challenges, clarifying the technical problems, and presents the solutions that have been proposed. The seminar concludes with new research directions in this area to promote further research.

Bio: Udaya K. Madawala graduated with a B.Sc. (Electrical Engineering) (Hons) degree from The University of Moratuwa, Sri Lanka in 1987, and received his PhD (Power Electronics) from The University of Auckland, New Zealand in 1993 as a Commonwealth Doctoral Scholar. At the completion of his PhD, he was employed by Fisher & Paykel Ltd, New Zealand, as a Research and Development Engineer to develop new technologies for motor drives. In 1997 he joined the Department of Electrical and Computer Engineering at The University of Auckland and, at present as a Full Professor, he focuses on a number of power electronics projects related to planning of EV charging infrastructure, and bi-directional wireless EV charging systems for V2X applications.

Udaya is a Fellow of the IEEE and a Distinguished Lecturer of the IEEE Power Electronic Society (PELS), and has over 30 years of both industry and research experience in the fields of power electronics and energy. He has served both the IEEE Power Electronics and Industrial Electronics Societies in numerous roles, relating to editorial, advisory, conference, technical committees and chapter activities. Currently, Udaya is an Associate Editor for IEEE Transactions on Power Electronics, and a member of both the Administrative Committee and Membership Development Committee of the IEEE Power Electronics Society. He was the General Chair of the 2nd IEEE Southern Power Electronics Conference (SPEC)- 2016, held in New Zealand, and is also the Chair of SPEC Steering Committee. Udaya, who has over 300 journal and conference publications, holds a number of patents related to wireless power transfer (WPT) and power converters, and is a consultant to industry.

Conference Schedule

Day 1, Dec. 18, 2021, Saturday, Beijing Time, GMT+8

Time/ Venue	Schedule
Morning Zoom Link: https://zoom.us/j/96203075575 Password：121820	
	Host Dr. Shenxi Zhang Shanghai Jiao Tong University, China
9:00-9:05	**Welcome Message** **Shanghai Jiao Tong University, China**
9:05-9:10	**Opening Remarks** **Prof. Haozhong Cheng** CSEE Fellow, IET Fellow **Shanghai Jiao Tong University, China**
9:10-9:55	**Keynote Speech 1** **Speech Title: Application of wireless power transfer in electric aircraft, railway, ships, and road vehicles** **Prof. Chris Mi** IEEE Fellow & SAE Fellow **San Diego State University, USA**
9:55-10:40	**Keynote Speech 2** **Speech Title: Challenge to Realization of 99.9% Power Conversion Efficiency Inverter and Its Application Fields** **Prof. Atsuo Kawamura** IEEE Fellow **Yokohama National University, Japan**
10:40-11:00	**Group Photo and Break Time**
11:00-11:45	**Keynote Speech 3** **Speech Title: EV Charging: Technical Challenges** **Prof. Udaya Madawala** IEEE Fellow Distinguished Lecturer of the IEEE Power Electronic Society **University of Auckland, New Zealand**

11:45-13:30	Break Time 	
Room 1 **Zoom Number: 962 0307 5575** **Password: 121820**	**Room 2** **Zoom Number: 916 8602 1996** **Password: 121820**	**Room 3** **Zoom Number: 967 5022 8536** **Password: 121820**
Session 1 13:30-16:15	**Session 2** 13:30-16:15	**Session 3** 13:30-16:15
Session 4 16:30-18:45	**Session 5** 16:30-18:45	**Session 6** 16:30-18:45

Day 2, Dec. 19, 2021, Sunday, Beijing Time, GMT+8

Time/ Venue	Schedule
Room 1 **Zoom Number: 962 0307 5575** **Password: 121820**	**Room 2** **Zoom Number: 916 8602 1996** **Password: 121820**
Session 7 9:00-11:45	**Session 8** 9:00-12:15
Session 9 13:30-16:00	**Session 10** 13:30-16:00
Session 11 16:15-18:45	**Session 12** 16:15-18:30

Day 3, Dec. 20, 2021, Monday, Beijing Time, GMT+8

Time/ Venue	Schedule
Room 1 **Zoom Number: 962 0307 5575** **Password: 121820**	**Room 2** **Zoom Number: 916 8602 1996** **Password: 121820**
Session 13 9:30-12:00	**Session 14** 9:30-12:00
Session 15 13:30-16:00	**Session 16** 13:30-16:00
Closing Ceremony 16:20-16:40	

Session 1: Power Load Forecasting and Calculation Model

Time: 13:30-16:15, Dec. 18, 2021, Beijing Time, GMT+8
Session Chair: Prof. Han Song, Guizhou University, China
Zoom Link: https://zoom.us/j/96203075575 Password：121820

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13:30-13:45

Design of Linear Regression Scheme in Real-Time Market Load Prediction for Power Market Participants
Authors: Tianjian Zhang, Jingpei Zhang, Yanbo Liu, Shuyan Pan, Dan Sun, Congcong Zhao
Presenter: Zhang Jingpei, Guangzhou Research Institute of Zhejiang Wanliyang Energy Technology Co., Ltd , China

Abstract: Linear regression is a simple but effective method for data fitting to implement prediction. Research of linear regression approach for real-time power load prediction was introduced in this paper for power market participants. With model simplification and precision improvement application by stepwise AIC method and Cook's distance analysis for model simplification and precision improvement, the prediction scheme is aiming at designing easy and reliable prediction scheme to provide market participants optimized trading decision support among day-ahead and real time spot power market.

P51

13:45-14:00

Load Characteristics Classification of Multiple Users Based on Time Series Clustering
Authors: Wei Xiao, Tong Ding and Hongkun Chen
Presenter: Wei Xiao, Wuhan University, China

Abstract: The traditional clustering methods exhibit insufficient accuracy when dealing with the load curves of a large number of users. To solve this problem, a time series clustering-based method for load characteristics classification of multiple users is proposed. First, the typical load curve shape of a single user is extracted. Then, considering the typical load characteristics of different users, the Canopy and k-shape time series clustering algorithms are used to cluster the load time-series data of multiple users. Moreover, the multiple users are classified into different types of power consumption. Through case studies based on field load data of a certain regional power grid, the results show that the proposed method can classify the load characteristics of multiple users more accurately than traditional methods

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14:00-14:15

Research on the Method of Station Load Prediction Based on SVR Optimized by GS-PSO
Authors: Xiaokun Yang, Tongjia Wei, Chengfei Qi, Peisen Yuan
Presenter: Peisen Yuan, Nanjing Agricultural University, China

Abstract: Power load forecasting in the station area of power grid can ensure the reliability of the power distribution network in the station area, and it is a crucial means to ensure the correctness of managers' decisions. Therefore, aiming at the problem of low accuracy of power load forecasting, this paper adopts the support vector regression model optimized by particle swarm and grid search to predict the load. First, we use the k-nearest neighbor method to fill in missing values and deal with outliers. Then, the wavelet transform is used to remove the noise in the data and improve the data quality. Then, we use the support vector regression algorithm to train the prediction model. To improve the prediction accuracy of the model, we use the particle swarm optimization algorithm combined with the grid search algorithm to find the optimal parameters of the SVR. Experiment shows that our algorithm has better prediction accuracy than other algorithms.

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14:15-14:30

Machine Parameter Correction of Heat Load Model Based on Particle Swarm Optimization

Authors: Xueyong Tang, Zhiyong Yuan, Ruifeng Zhang, Jinyong Lei, Yu Zhang, Shuhui Pan, Zhen Li, Hao Bai
Presenter: Xueyong Tang, Power Grid Planning & Research Center, Guizhou Power Grid Co., Ltd., China

Abstract: Accurate prediction of the thermal load is critical for heat supply system control. A thermal load forecasting algorithm employing physical models and particle swarm optimization is proposed in this paper. The thermal model was derived by establishing the energy conservation equation based on physics laws. The model parameters were tuned by particle swarm optimization with operational data. The proposed algorithm was tested with actual two-week heating data. The test results demonstrate the proposed algorithm achieves an accurate and stable prediction of thermal load, and abnormal data and accumulation of forecasting errors over time were not observed.

P08

14:30-14:45

Research and early warning method for power quality situation of active distribution network based on clustering GA-BP

Authors: Husheng Yao, Dong Guan, Mingming Wang, Mingzhuo Chu, Liangchen Liu and Siqi Liu
Presenter: Husheng Yao, Nanjing University of Posts and Telecommunications, China

Abstract: After large-scale distributed power generation (DG) is connected to the grid, due to the gap and randomness of DG's flexible access output, it is difficult for traditional prediction models to obtain more accurate situation predictions. Therefore, a power quality research and judgment method of active distribution network (ADN) based on density mathematics K-means (DMK-means) clustering and BP neural network is proposed to solve the problem of difficult situation prediction. By improving the DMK-means algorithm to divide the input variables into different sub-categories, reducing the dimensionality of the kernel matrix, and using the BP model for training and performance evaluation for each type of data set, and then using the genetic algorithm (GA) to optimize the BP nerve The network model is used to predict and judge the power quality index items of the active distribution network. The power quality status can reflect the power grid situation from the side, and then build an early warning mechanism to predict the future status of the distribution network. Finally, examples and application analysis verify the practicability and effectiveness of the designed power quality prediction and early warning mechanism.

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14:45-15:00

Deep Reinforcement Learning Based Load Control Strategy for Combined Heat and Power Units

Authors: Ge Xie, Chenggang Cui, Huirong Zhao, Jiguang Yang, and Yunfei Shi
Presenter: Ge Xie, Shanghai University of Electric Power, China

Abstract: A deep reinforcement learning (DRL) control strategy is proposed for automatic generation control (AGC) operation of the combined heat and power (CHP) units under varying power system dynamic conditions. Firstly, a Markov decision process (MDP) model and a deep deterministic strategy (DDPG) algorithm are used to enhance the load control stability of the CHP units. Secondly, a reward and punishment mechanism is proposed to ensure the control performances of the main steam pressure, the power output, and the extraction pressure in CHP units. Due to the rapid adaptability of DRL, the stability time and the fluctuation range of these control performances are significantly reduced when the AGC disturbance occurs. Finally, the control effect of DRL has more superiority compared with the traditional PID feedback control strategy.

P151

15:00-15:15

Deep-Learning-Based Thickness Detection Method of Ice Covering
Authors: Xinyu Pi, Guoyong Zhang, Lifu He, Wenqing Feng, Jing Luo and Yi Ouyang
Presenter: Xinyu Pi, State Key Laboratory of Disaster Prevention and Reduction for Power Grid Transmission and Distribution Equipment, China

Abstract: Accurate and timely monitoring of icing is of great significance for improving the power grid's disaster prevention and mitigation capabilities and ensuring the safe operation of the power grid. However, the current icing thickness monitoring technology cannot meet actual application requirements in terms of automation and accuracy. As an emerging artificial intelligence technology, deep learning algorithms have been widely used in the field of computer vision. Aiming at the shortcomings of the existing methods for icing thickness recognition, this paper proposes an intelligent recognition method for power grid icing thickness based on the Mask R-CNN model in deep learning. First, image enhancement of the sample data is performed based on the deep learning image enhancement technology, and then the icing thickness sample image database is constructed, and finally the icing thickness recognition is performed based on the Mask R-CNN model. Experimental results show that the method proposed in this paper can achieve high recognition accuracy for all types of icing grades. The quantitative analysis results show that the mAP, mAP50 and mAP75 of the model recognition results are 0.634, 0.966 and 0.779, respectively. The icing thickness identification method based on deep learning proposed in this paper can effectively monitor the icing of power grid equipment, and has an important theoretical guiding role for power grid disaster prevention and mitigation

P145

15:15-15:30

Prediction of Battery Remaining Capacity in Space Power System Using Extreme Learning Machine
Authors: Shenggen Zheng, Wentao Huang, and Qinqin Fan
Presenter: Shenggen Zheng, Shanghai Maritime University, China

Abstract: State of a storage battery in the space power system is the most factor for the spacecraft safety. Therefore, how to estimate the remaining capacity of the battery is a vital task. To end this, a prediction model of battery remaining capacity is proposed in the current study. In the proposed model, the extreme learning machine (ELM) is used and a grid search is applied to find its optimal hyperparameters. Experimental results show that the prediction accuracy of the proposed model is better than that of other competitors. Moreover, the proposed algorithm uses less time.

P162

15:30-15:45

On-line Monitoring Method of Transmission Tower Tilt Based on Remote Sensing Satellite Optical Image and Neural Network
Authors: Leyi Li, Xuelian Gao and Wenlin Liu
Presenter: Leyi Li, North China Electric Power University, China

Abstract: Transmission tower is the infrastructure to ensure the operation of the power grid. For long-term monitoring the tilt of transmission towers, an online monitoring method of tower tilt based on remote sensing satellite optical image and neural network is proposed. Firstly, The K-means clustering algorithm is used to segment shadows of towers, and the Hough line detection algorithm is used to extract the contours of tower shadows. Then, according to the results of image processing and the actual tilt, a data set is made to train the Back Propagation (BP) neural network. Finally, the trained neural network is used to determine the tilt of the image to be discriminated. The neural network is capable of achieving over 90% accuracy with a small training set. The correct rate of the tilt discrimination result of the actual selected sample is 100%, and the discrimination accuracy rate of the simulated sample is 87.5%. Compared with other methods, this method is fast in calculation, low in cost, and has engineering application value.

P142

15:45-16:00

Energy Data Collection and Scheduling of AMI Based on Consistent Hash and Greedy Optimization

Authors: Fuxing Huang, Meng Sun, Jiachen Zhong, Neixuan Liu, Peisen Yuan
Presenter: Jiachen Zhong, Nanjing Agricultural University, China

Abstract: Efficient access to smart meter data is of great significance to the stable operation of AMI. However, the traditional power grid system still has problems such as unbalanced distributed storage load and low efficiency. Aiming at the problem of system performance deterioration caused by the rapid increase in the amount of energy data, this paper proposes a scheduling method based on consistent hash and greedy algorithms to optimize the storage, query and analysis process of smart meter data. First, different hash algorithms are researched. Then the SHA-1 algorithm with better effect is selected and put into use. After that, consistent hash is used to optimize the performance of distributed storage. Finally, the node selection strategy can be adjusted based on the greedy algorithm, and the appropriate greedy threshold parameter is statistically summarized. The experimental results show that our method is effective

P195

16:00-16:15

Impact of Load Variability Modelling on Probabilistic Power System Transient Stability

Authors: Siyanda Ncwane, Komla A Folly
Presenter: Siyanda Ncwane, University of Cape Town, South Africa

Abstract: Load in a power system is variable due to changes in customer demand. Probability distribution functions (PDFs) are commonly used to model power system load variability. The PDFs are generally selected based on their fit to load density. However, it cannot be guaranteed that PDFs selected based solely on their fit to load density model the load range. PDFs that model the load range can synthesise maximum and minimum load values. The ability of PDFs to synthesise maximum and minimum load values ensures that the modelled load can be used to develop the power system peak and minimum demand. In this paper, PDFs are selected based on: (1) having a good fit to load density and (2) their ability to synthesise the load range. The results show that PDFs with a good fit to load density and that also model the load range result in power system transient stability results that are similar to those produced when measured load is used.

Session 2: Electrical Insulation and Condition Monitoring

Time: 13:30-16:15, Dec. 18, 2021, Beijing Time, GMT+8
Session Chair: Assoc. Prof. Jixing Sun, Beijing Jiaotong University, China
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P20

13:30-13:45

Methane and Acetylene Detection in Transformer Oil Based on Raman Spectroscopy
Authors: Guangmao Li, Shengya Qiao, Chen Zhu, Sen Yang, Wenxiong mo and Yong Wang
Presenter: Guangmao Li, Guangzhou Power Supply Bureau of Guangdong Power Grid Co., Ltd., China

Abstract: In order to detect the characteristic gas generated by oil-paper insulation aging in the power transformer. Protecting the safety and stability of the power system. Raman spectroscopy-based detection technology was introduced to achieve sensitive and accurate measurement. In this paper, theoretical and experimental Raman spectra of methane and acetylene are obtained based on quantum chemistry methods and cavity enhanced Raman spectroscopy. The Raman spectra of methane and acetylene were compared and analyzed, the attribution of the Raman peak was determined, and the vibration mode of the molecule was analyzed. It is found that the detection method based on Raman spectroscopy can effectively identify the characteristic peaks of methane and acetylene, laying a solid foundation for its quantitative detection.

P38

13:45-14:00

Insulator detection based on deep learning method in aerial images for power line patrol
Authors: Zheng Huang, Hongxing Wang, Bin Liu, Jie Zhu, Wei Han, Zhaolong Zhang
Presenter: Wei Han, Shenzhen DY Power AI Co., Ltd. , China

Abstract: Insulators play an important role of supporting wires and insulating in power lines, and insulator detection using aerial images has became a trend in power line patrol. However, traditional visual detection methods are usually less accurate and less robust due to the complex image background. To solve this problem, this paper propose a novel and efficient deep learning based method to detect insulator in aerial image. First, the ResNet network pre-trained on ImageNet dataset is adopted as the backbone network of the proposed network. Then, a cascaded convolution module is designed to extract composite insulator features corresponding to multiple receptive fields. To make the proposed network to learn the most powerful insulator features, SPP module and SE module are introduced into the detection headers of the proposed network. Experimental results verify that the proposed network achieves higher accuracy than six existing networks.

P15

14:00-14:15

Dielectric Loss Measurement Algorithm Based on Oscillating Wave Testing Technology
Authors: Ying Yu, Yincheng Gao, Qishen Lv, Lin Zhang, Xiaolong Xu and Hongjie Li
Presenter: Yincheng Gao, Xi'an Jiaotong University, China

Abstract: Dielectric loss is one of the important indicators to evaluate the insulation status of power cables. Oscillating wave voltage, as a new emerging detection voltage, has a wide range of applications in the field of partial discharge detection due to its good equivalence with power frequency AC voltage. However, the oscillation wave voltage has not been deeply developed for dielectric loss measurement work. Integrated detection has limitations. In order to solve the current limitations, this paper proposes a method for measuring cable dielectric loss based on oscillating wave testing technology. During each working period of the oscillating wave test system, the voltage and current data of the cable sample are collected, and then the waveform parameters are extracted through data postprocessing to obtain accurate dielectric loss. Finally, the simulation results verify the feasibility and effectiveness of the method

P19

14:15-14:30

Detection of CO and CO2 dissolved in Transformer Oil based on Raman Spectroscopy and Neural Network

Authors: Chen Zhu, Guangmao Li, Shenya Qiao, Fuli Zheng and Jianping Deng
Presenter: Chen Zhu, Guangzhou Power Supply Bureau of Guangdong Power Grid Co., Ltd., China

Abstract: Transformer is an important part of power system, its life mainly depends on the mechanical strength and electrical integrity of its insulation. CO and CO2 are one of the main fault characteristic gases dissolved in transformer oil. Thus, monitoring the CO and CO2 dissolved in transformer oil is considered by the power industry as an important means to ensure the safe operation of power systems. This work proposes the measurement of the CO and CO2 dissolved in transformer oil using Raman spectroscopy and generalized regression neural network (GRNN). Firstly, 200 samples were divided into training sets and test sets. After that, Raman spectroscopy as the input of GRNN, and The concentration of CO and CO2 dissolved in transformer oil as the output of GRNN. Afterwards, the experimental method was incorporated to get the best smoothing factor σ for GRNN. Then, the GRNN with the best smoothing factor σ=24 was trained with the training sets, and the model was verified with the test sets. The experimental results show that the prediction accuracy of the prediction model of the CO and CO2 dissolved in transformer oil based on GRNN is 90%. It also provides a new method for evaluating the health of transformer.

P104

14:30-14:45

Research on Gas Movement Law of Fault Discharge in Transformer Oil

Authors: Xiu Zhou, Tian Tian, Ningbo Liu, Yan Luo, Xiuguang Li, Ninghui He, Yunlong Ma, Jun Sun
Presenter: Xiu Zhou, Electric Power Research Institute of State Grid Ningxia Electric Power Co., Ltd, Yinchuan, China

Abstract: Power transformers always experience problems such as ageing, overheating or discharging faults during the process of the transformer, resulting in the decomposition of the insulating superheating paper and the insulating oil. This phenomenon leads directly to the generation of dissolved gases in the oil, which diffuses through the oil and then reaches equilibrium. In this paper, molecular dynamics is the main focus. The amorphous crystals of cycloalkyl oil and small molecules of characteristic gases are established by using Materials Studio software. The diffusion behaviour of small molecules in cycloalkyl oil is simulated and the mean square displacement of characteristic gases is calculated by using COMPASS force field. According to Einstein's equation, the relationship between mean square displacement and diffusion coefficient is obtained. The intensity of diffusion ability of the characteristic gases in the cycloalkyl oil is obtained by comparing seven different characteristic gases and seven diffusion coefficients of different characteristic gases. The effect of temperature on the diffusion ability of small molecules with different characteristics in naphthenic alkyl oils was studied by setting different temperatures. The diffusion law of typical characteristic gas in insulating oil is discussed, which provides a theoretical basis for improving DGA technology, in order to improve the accuracy of DGA technology in transformer fault judgment.

P99

14:45-15:00

Study on the Audible Acoustic Features of Dry-Type Reactor under Typical Insulation Defects

Authors: Zhou Xiu, Tian Tian, Luo Yan, Zhang Pengcheng, Li Xiuguang, He Ninghui, Liu Weifeng, and Sun Jun
Presenter: Zhou Xiu,Power Science Research Institute of State Grid Ningxia Power Co. Yinchuan, China

Abstract: Dry-type reactor is an important equipment in the power grid system, but the features in time and frequency domain of its audible signal under typical insulation defect

discharge are not clear yet, which makes it hard to effectively carry out the fault diagnosis of dry-type reactor based on audible signal. Based on this, this paper builds a dry-type reactor audible signal insulation test platform based on a 10 kV dry-type reactor, sets up two kinds of insulation defects: winding lead wire aging fracture and metal burr defects, collects its discharge audible signal, and compares and analyzes the time and frequency domain features of the discharge signal, and gets the following conclusions: the discharge signal of winding lead wire aging fracture is obvious periodically, and the discharge signal of metal burr defects is in the shape of "Hump" with the period of 20 ms. Based on the study of acoustic feature of power spectrum, it is found that the acoustic power spectrum of winding lead wire aging fracture discharge has three-band feature, and the frequency point of average power is near 10 kHz. The power spectrum of metal burr defect discharge has double-band feature, which is mainly composed of high-frequency components. This study provides some technical support for the further development of dry-type reactor operating condition detection and evaluation based on audible acoustic.

P26

15:00-15:15

Research on the Influence of Temperature on the Frequency Domain Spectroscopy Characteristics of AC Oil-Paper Insulated Bushings

Authors: Zhicheng Pan, Jun Deng, Xiang Peng, Zhicheng Xie, Jinyin Zhang
Presenter: Zhicheng Pan, Maintenance & Test Center of EHV Power Transmission Company, China Southern Power Grid, Co., Ltd, China

Abstract: This paper introduced the test of frequency domain spectroscopy (FDS) of AC oil-paper insulated bushings, and explained the principle of FDS technology and temperature dependence mechanism. 72.5kV, 110kV, and 220kV OIP bushings were chosen as test samples to carry out temperature correlation research, and explained the influence mechanism of temperature on the FDS characteristics of the bushings, and proposed temperature correction method based on Arrhenius equation. The field application verified the effectiveness of temperature correction method and the insulation evaluation of OIP bushings.

P168

15:15-15:30

Insulator infrared image segmentation algorithm based on dynamic mask and box annotation

Authors: Tong Li, Jinhui Zhou, Guoliang Song, Yonghua Wen, Yuanhao Ye and Sijun Chen
Presenter: Tong Li, Southern power grid materials Co., Ltd., China

Abstract: Aiming at the problems of inaccurate positioning, low recognition efficiency, and difficult segmentation of insulator image in complex background, an insulator infrared image segmentation algorithm based on the dynamic mask and box annotation is proposed. In the conditional convolution instance segmentation network framework, the single-shot and high-performance box-supervised methods are introduced, and the mask-level loss is used to replace the pixel-level loss. By marking the insulators in the infrared image with a rectangular frame, the algorithm can realize the overall segmentation of the insulator string. The experimental results show that the algorithm uses the ResNet-101-FPN backbone and 3× training plan to train a large number of infrared images, which can achieve accurate identification and high-precision segmentation of insulators, and demonstrate excellent segmentation performance.

P154

15:30-15:45

Influence of different measuring positions on infrared detection of deteriorated composite insulators

Authors: Yuan Chen, Shuochao Fan, Yi Lu, Xu Zhang, Jingzhe Yu, Shuyuan Wang, Dewen Wang, and Yanfeng Gao
Presenter: Jingzhe Yu, Electric Power Research Institute State Grid Jibei Electric Power Co.,Ltd., China

Abstract: Infrared detection of composite insulators by manual and aircraft patrol is an effective measure to find the deterioration and defects of composite insulators. However, the measuring position will have a great impact on the infrared measurement of composite insulators, which needs to be deeply studied. In this paper, the infrared detection tests at different positions were carried out for the deteriorated composite insulator taken from the transmission line, and the variation characteristics of the maximum temperature, minimum temperature and temperature difference of the deteriorated composite insulator with the test time at different measuring positions are obtained. It is found that when the measuring position is perpendicular to the deterioration position of the composite insulator string, the influence of adjacent insulators on defect detection is the smallest. Moreover, the conclusion is verified by the helicopter infrared temperature measurement test of the actual composite insulator at different positions.

P105

15:45-16:00

The detection of CO gas based on non-resonant photoacoustic spectroscopy

Authors: Cheng Jun, Bian Chao, Chen Xuan, Tao Jiagui, Gan Qiang, Zhang Zhengdong, Cui Ruguang, Tan Tingyue
Presenter: Cheng Jun, Nanjing University, China

Abstract: CO gas is the product of solid insulating material in the fault area of SF6 in GIS. The fault type can be effectively evaluated by detecting the content of Co. Based on the photoacoustic spectroscopy detection technology, the detection platform of non resonant photoacoustic spectroscopy is built. Through the verification of the coherence formula of photoacoustic cell volume, it is obtained that in the case of non resonance, the intensity of photoacoustic signal is negatively correlated with the radius of photoacoustic cell and independent of the length of photoacoustic cell. A photoacoustic cell with a radius of 3 mm is designed. Before the experiment, the system noise of the experimental platform is detected, and the noise value is 0.322mv. The quantitative detection experiment of CO gas is carried out, and the correlation coefficient of 0.993 is obtained. The inversion of CO gas concentration signal is calculated, and the relationship between gas content and photoacoustic signal is obtained. Finally, the detection limit of CO and the signal-to-noise ratio are explored, and the signal-to-noise ratio of the lowest concentration is 2.44. Thus, the detection limit of CO gas is 8.2ppm. Through the experiment and exploration of quantitative detection of CO gas, it lays a foundation for effectively evaluating the operation status of power equipment.

P06

16:00-16:15

Development of a Novel Capacitive Partial Discharge Coupling Sensor for Cable Detection

Authors: Lin Zhang, Qishen Lv, Zhiren Tian, Saike Yang, Xianyu Yue, Junbai Chen
Presenter: Saike Yang, Xi'an Jiaotong University, China

Abstract: The partial discharge detection is a proposed method to assess the insulation condition of the power cable. Conventionally used partial discharge couplers with narrow bandwidth can not meet the high sensitivity requirements of long cable testing. This paper presented a novel partial discharge coupler based on the RLC capacitive coupler. The designed coupler meets the requirements of higher low-frequency attenuation, lower passband frequency and high partial discharge detection sensitivity. The coupler is implemented and tested in the laboratory and the results are satisfactory.

Session 3: Distribution Network Planning and Optimal Operation

Time: 13:30-16:15, Dec. 18, 2021, Beijing Time, GMT+8
Session Chair: Assoc. Prof. Peng Kou, Xi'an Jiaotong University, China
Zoom Link: https://zoom.us/j/96750228536?pwd=d2hGWW9uekVqL0Z6K1YvYmtwVHhPQT09
Password：121820

P17

13:30-13:45

Optimal Configuration of Converter and Energy Storage Capacity in DC Distribution System Based on Overload Risk
Authors: Yingyong Jian, Xinsen Xu, Jing Wang, Yuming Zhao and Xidong Xu
Presenter: Yingyong Jian, Zhejiang University, China

Abstract: DC distribution system can more effectively undertake DC load, photovoltaic components and energy storage. Because of the access of charging piles and the penetration of renewable energy, the size of load will be more and more uncertain. While the application of energy storage can smooth load fluctuation. And how to optimize the allocation of power source, energy storage capacity and power is a challenge. In this paper, the time series probability model is applied to represent the uncertainty of load. Based on the probability model, two types risk of overload are analyzed, one is caused by the power shortage, another is caused by energy shortage. Taking the maximization of DC system power supply income as the goal, considering the investment and operation cost of converter and energy storage, the DC system income objective function is established. Then the gradient descent method is employed to solve the function. Finally, several examples of the optimal allocation are given.

P123

13:45-14:00

Calculation of optimal segment number of MV overhead single radial line considering user distribution
Authors: Song Youle, Wang Zijun, Wang Ke, and Wang Chengmin
Presenter: Wang Zijun, Shanghai Jiaotong University, China

Abstract: Segmentation is an important factor affecting the reliability level of medium voltage overhead lines. How to determine the optimal number of segments of medium voltage overhead lines is one of the difficulties in distribution network planning. Different from the assumption that users are evenly distributed in the past reliability analysis, this paper further analyzes and discusses the influence of uneven distribution of users on the reliability level and optimal number of sections of medium voltage overhead single radial lines. Firstly, the mathematical model of different user distribution is established, and then the quantitative calculation formula of reliability index and optimal number of segments under different user distribution is derived based on analytical method. Furthermore, the expression of optimal number of segments considering user distribution is proposed considering economy and reliability. The simulation example verifies the correctness of the theoretical derivation.

P112

14:00-14:15

Multi-Objective Optimal Placement of Three-Phase Step Voltage Regulator considering Voltage Unbalance
Authors: Akito Nakadomari, Narayanan Krishnan, Ashraf Mohamed Hemeida, Hiroshi Takahashi and Tomonobu Senjyu
Presenter: Akito Nakadomari, University of the Ryukyus, Japan

Abstract: The trend of energy decarbonization accelerates the transition towards decentralized power distribution systems. However, the growth of distributed generation and loads may increase voltage unbalance in distribution systems. Consequently, it is essential to plan and operate the systems considering voltage unbalance to avoid some problems caused by unacceptable voltage unbalance. This paper proposes an optimal placement method for three-phase individually controlled step voltage regulators

(3ΦSVRs) considering voltage unbalance. A multi-objective bi-level optimization model is constructed to consider optimal placement and operation simultaneously. The optimal placement considers the trade-off between distribution losses and device costs, while the optimal operation minimizes the losses under the constraints of the voltage profile. Cooperative operation with a load ratio control transformer (LRT) is also incorporated in the optimization problem. The proposed method is tested using the IEEE 123 node test feeder. Results identify optimal placements for each number of devices and allow placement according to the preferences of distribution system operators.

P32

14:15-14:30

Voltage Control Strategy Considering Security Constraints of Predictive Fault Set
Authors: Jing Bai, Tianhua Chen, Haiyun Wang, Jianhua Chen, Shaoqing Xi, Lei Du
Presenter: Tianhua Chen, NARI Technology Co., Ltd. , China

Abstract: With the development of AC/DC hybrid power grids and a high proportion of new energy sources, grid operation risks have increased. The voltage constraints in traditional automatic voltage control systems are generally given offline, which may not be able to meet the requirements of security and stable operation of the actual voltage of the power grid. It is necessary to comprehensively consider the voltage security region under grid fault to support the security and stable operation of the grid. This paper proposes a voltage control strategy that considers the voltage security region of the predictive fault set. Through the defined predictive fault set, analyze and evaluate the voltage operation risk under the fault, add voltage security region to the existing voltage control model to ensure that the voltage is qualified and security, reduce the voltage risk at the time of fault, and realize the active control of the voltage. Finally, through simulation analysis, the effectiveness of the proposed method is verified and it has a certain promotion value.

P193

14:30-14:45

Framework Planning of Distribution Network with High Proportion of Distributed Renewable Energy Sources
Authors: Zhuo Cheng, Weidong Zeng, Hai Ci, and Longlong Shang
Presenter: Zhuo Cheng, Shenzhen Power Supply Bureau Co., Ltd., China

Abstract: In order to complete the requirements of distribution network planning and overcome the randomness and volatility of distributed renewable energy after high proportion of distributed renewable energy are connected, a bi-layer programming model considering the uncertainty of distributed new energy is established in this paper. Firstly, active management measures are considered on the basis of framework planning, the upper-level planning take the least overall annual cost as goal, and the lower-level model take the least amount of distributed generation output removal as goal. Secondly, considering the operation of the distribution network, the reliability constraint is added to the upper-level model. Then, Monte Carlo sampling method is used to obtain random wind speed and light intensity. The upper model is solved by a partheno-genetic algorithm encoded by tree structure, and the lower model is solved by a mixed-integer second order cone programming method. Finally, the validity of the model is verified by the 29-bus system.

P196

14:45-15:00

Simultaneous Feeder Resonance Damping and Load Current Harmonic Compensation using Multi-Functional DG Units
Authors: Rina Su, Junfei Han, Yifan Zhang, Yuqiang Wang, Chaoyu Yu and Jinwei He
Presenter: Rina Su, Inner Mongolia Power Research Institute, China

Abstract: In this paper, a novel multi-functional distributed generation (DG) unit is proposed for active harmonic control of low voltage distribution networks. The proposed system combines the functions of both power generation and active harmonic compensation in the DG interfacing converters. The active harmonic control is achieved by controlling the performance of the converter at the selective harmonic frequency as a

controlled harmonic current source to absorb local load harmonics and a controlled harmonic virtual resistor to damp out the feeder resonance. It has been demonstrated that there is no interference between the multiple control objectives. Simulation results have been provided to validate the correctness of the proposed approach.

P156

15:00-15:15

Droop Control Strategy of DC Distribution Network Considering Voltage Regulation Range

Authors: Zeli Zhang, Jianyuan Xu, Gaole Yu and Dong Zhao
Presenter: Zhang Zeli, Shenyang University of Technology, China

Abstract: With the rapid development of distributed renewable energy, the AC distribution network is facing huge challenges. In comparison, the DC distribution network has many advantages. However, the control of the DC distribution network is complicated, and the only indicator to measure the power balance of the DC distribution network is the DC voltage. Therefore, in the DC distribution network, the control of DC voltage is important. This paper firstly compares the AC power distribution network and the DC power distribution network, and summarizes the advantages and disadvantages. Secondly, the topology structure of the DC distribution network is introduced, and the operation principle of constant DC voltage control and traditional droop control is compared. Aiming at the shortcomings of the both, an innovative voltage droop control strategy considering the voltage regulation range and power transmission limit is proposed. Finally, a two-terminal flexible DC distribution network simulation model with MMC is built in MATLAB/Simulink to verify the feasibility of the proposed control strategy.

P200

15:15-15:30

A Study on Objective Dimensionality Reduction of Unbalanced Distribution System Operation

Authors: Akito Nakadomari, Narayanan Krishnan, Mohammed Elsayed Lotfy, Ashraf Mohamed Hemeida, Hiroshi Takahashi and Tomonobu Senjyu
Presenter: Akito Nakadomari, University of the Ryukyus, Japan

Abstract: The penetration of distributed generators (DGs) causes voltage unbalance issues in distribution systems. The issues increases the number of objectives in distribution system operation, making it more challenging to achieve optimal operation. Reducing the dimensionality of the objectives by revealing the correlations between objective functions is a practical approach to such challenges. This paper reports reduction of objective functions in an optimal operation problem of unbalanced power distribution systems. Four typical objectives, including voltage unbalance, are considered, and correlations are analyzed by principal component analysis (PCA). In addition, comparisons are made under different constraints. Despite the results revealing two significant conflicts between the objective functions, performing objective reduction using PCA is challenging in many cases. However, the Pareto fronts of some objective functions indicate the existence of reasonable knee points, suggesting that further objective dimensionality reduction may be achieved by integrating some objective functions based on the knee point.

P74

15:30-15:45

Topology Identification of Intelligent Distribution Network Based on 1D-CNN

Authors: Yingjie Tian, Fan Li, Yi Wu, Jiafu Jiang, Chengze Li and Xiu Yang
Presenter: Jiafu Jiang, Shanghai University of Electric Power, China

Abstract: Aiming at the problem that the topology of distribution network changes frequently and it is difficult to obtain the topology,a distribution network topology identification method based on one-dimensional convolutional neural network is proposed.The convolution neural network is used to mine and learn the characteristics of the measured data,and the obtained model is used to identify the distribution network topology.The proposed method only needs time section data for topology

identification,which is not only suitable for radial network,but also suitable for looped network.The effectiveness of the proposed method is verified by IEEE33 node distribution network connected to distributed energy.

P201

15:45-16:00

Enhancing Security of Supply Using Battery Energy Storage Systems in Distribution Networks in UAE

Authors: Omar Al Ahamd, Maha Aldahmi
Presenter: Omar Alahmad, AlAin Distribution Company, UAE

Abstract: In this paper, different energy storage technologies are explored according to IEEE standards. The main objective is to utilize Energy Storage Systems (ESS) and specially Battery Energy Storage (BES) at the distribution level as ancillary (network support) services. Then, a review inline to latest implemented project in the Abu Dhabi for best BES for UAE environment is discussed as an alternative solution to secure the unsecured 11kV rings –non complying network arrangements with regulatory standards– in the distribution network. A case study based on real measurements is investigated to achieve avoid investment in reinforcing the power network in the traditional ways. Finally, additional benefits of having small BES systems installed across the distribution network is highlighted.

P167

16:00-16:15

Comprehensive benefit evaluation model considering the interaction between distribution network and prosumers

Authors: Xiang Zheng, Zhiquan Meng, Mingcheng Xie, Qixin Wang, and Kai Yang
Presenter: Qixin Wang, Southeast university, China

Abstract: As the penetration rate of photovoltaic and other renewable energy in the distribution network continues to increase, the load side gradually changes from a single electricity consumption form to a producer with dual characteristics of electricity generation and consumption. Therefore, the interactive benefits between the distribution network and the prosumer need to be comprehensively evaluated. At present, most of the discussions on interaction benefit focus on the demand response of power users, and lack of discussion on the impact of energy sharing among users on interaction benefit. Therefore, this paper puts forward a comprehensive benefit evaluation model based on the interaction between distribution network and prosumer. Firstly, the power utility model of prosumer is constructed, then the practical calculation method of economic index and stability index in the interactive benefit is proposed combining with the load dispatching model of distribution network. Finally, an example is given to verify the validity of the model.

Session 4: Power Electronics Technology and Application

Time: 16:30-18:45, Dec. 18, 2021, Beijing Time, GMT+8
Session Chair: Assoc. Prof. Janis Zakis, Riga Technical University, Latvia
Zoom Link: https://zoom.us/j/96203075575 Password：121820

P16
16:30-16:45

A Low-noise Very Low Frequency Sinusoidal Generator
Authors: Xianyu Yue, Li Wang, Saike Yang, Jiaqi Tao, Kun Tang and Junbai Chen
Presenter: Xianyu Yue, Xi'an Jiaotong University, China

Abstract: In this letter, a novel very low frequency sinusoidal (VLF-sin) generator is proposed and established based on bidirectional two-stage voltage multiplier and module which includes a resistor connected in parallel with a bidirectional HV switch (R-T module). By changing the frequency of power supply at charging stage and resistance at discharging stage, a low-noise VLF-sin waveform can be generated which can be applied to partial discharge detection (PD). A test is carried out to prove the feasibility of the generator.

P58
16:45-17:00

Improved Lifetime Prediction Model of IGBT Module Considering Aging Effect of Solder Layer
Authors: Liu Long, Chunming Tu, Biao Xiao, Haoliang Xu, Shuaihu Liu
Presenter: Liu Long, Hunan University, China

Abstract: The insulated gate bipolar transistor (IGBT) module is the core component in a converter, and its aging failure monitoring and evaluation is of great significance to the safe and reliable operation of the system. In the physical lifetime model using an energy-based method, the fixed deformation energy in a single cycle is usually used to predict the lifetime, ignoring the influence of the module aging process on the deformation energy. In this paper, a lifetime prediction model of power modules which considers the aging effect of the solder layer is proposed. Firstly, the finite element method and Clech algorithm are used to form the stress-strain hysteresis loop of the solder joint under cyclic thermal load, and the area of the hysteresis loop is calculated to represent the magnitude of the deformation energy in a single cycle; secondly, the influence of aging process on deformation energy is analyzed. And the thermal resistance degradation is taken into account to improve the traditional lifetime model; finally, the differences between this model and the existing commonly used models are compared, and the accuracy of the model proposed in this paper is verified.

P48
17:00-17:15

Simulation Analysis of Totem Pole PFC Using Steady Error Free Quadratic Optimal PID Control
Authors: Wei Jiao, Yuhan Gao, Wei Yan, Shuang Wu, Fei Gao, Xijun Yang
Presenter: Wei Jiao, Shanghai Jiao Tong University, China

Abstract: The development of calculation methods and computer technologies promotes the engineering of modern control theory. In this paper, steady error free quadratic optimal PID control algorithm of totem pole power factor corrector (PFC) is designed by using the optimal PID control parameter selection method of linear quadratic regulation (LQR). After giving the double closed-loop LQR optimized PID control principle, the state space average model is established, the double closed-loop PID control algorithm of boost DC-DC converter is designed by using the LQR function of MATLAB, and then quadratic optimal PID control parameters of totem PFC under equivalent electrical conditions are designed by using the same double closed-loop PID control parameters, and the MATLAB/Simulink simulation circuit is built, the analysis results show that quadratic optimal PID control parameter optimization method of totem pole PFC is feasible.

P160

17:15-17:30

Analysis of influence of insulation failure of drive transformer on drive circuit of SiC MOSFET

Authors: Xu Guancheng, Lv Miao, Meng Xiangjun, Dong Xiaoshuai
Presenter: Lv Miao, Xi´an XJ Power Electronics Technology Co.,Ltd, China

Abstract: The driving circuit plays an important role in the normal operation of a power electronic product. The driving power supply with the driving transformer as the main device is an important part of the driving circuit. Therefore, the performance of transformer parameters has a great impact on the drive circuit. The distributed parameters in high-frequency transformer will have adverse effects on power electronic products. This paper focuses on the influence of insulation failure in distributed parameters on SiC MOSFET drive circuit. A driving circuit for SiC MOSFET is designed, and the hardware circuit of the circuit is built. The influence of insulation failure on the driving circuit is simulated by software, and the influence of insulation failure on the driving circuit is verified by hardware circuit.

P144

17:30-17:45

Experimental study on the effect of neutral point wiring method on transformer no-load current

Authors: Yang Bowen, Chen Tianxiang, Xu Huikai, Zhao Shenyuan, Yang Chunlan
Presenter: Bowen Yang, Chengdu University of Technology, China

Abstract: Transformer no-load test is an important test to detect the operating efficiency of the transformer and the presence of defects in the transformer core. When the three-phase regulator is connected to the mains to do the transformer no-load test, it is impossible to avoid the impact of unbalanced output test voltage on the no-load current. To this end, the test studied a 35kV power transformer no-load test, the test power, regulator and transformer neutral point of different connections on the transformer no-load current impact. Analysis of the neutral point of the different connection methods under the no-load current changes, to determine when the regulator neutral point and the power side of the neutral connection, even if the phase voltage unbalance rate of 10% will not affect the no-load current, so that the three-phase regulator to do the transformer no-load test when the neutral point of the best connection. This has some reference value for practical engineering applications.

P09

17:45-18:00

Research on Short-circuit Force of Transformer Winding with Single-phase Short-circuit and three-phase Short-circuit

Authors: Xiaoxiao Luo, Qianbo Xiao, Qian Wang, Wenyan Gan, Baojia Deng, Zhiping Sheng
Presenter: Xiaoxiao Luo, Equipment condition evaluation center State Grid Chongqing Electric Power Research Institute Chongqing, China

Abstract: When the transformer short-circuit occurs, the short-circuit current value in the winding wire can reach more than ten to dozens of times of the rated value. The interaction between the leakage magnetic field generated by the coil and the short-circuit current will produce electromagnetic force. Therefore, it is necessary to analyze the short-circuit force in different short-circuit modes. Based on a 200kVA distribution transformer, this paper establishes a finite element model and compares the short-circuit force under three-phase shortcircuit and single-phase short-circuit. The results show that the short-circuit forces of the two modes are basically the same.

P159

18:00-18:15

Simulation Research on Breaking Performance of 550kV 80kA SF6 Circuit Breaker under Different Opening Characteristics

Authors: Shengwu Tan, Hao Zhang, Miaoxin Li, Xiaohui Duan, Zhijun Wang and Bo Zhang
Presenter: Hao Zhang, Pinggao Group Co., Ltd, China

Abstract: With the continuous development of the power grid, the short-circuit current of the line is getting higher and higher. In some areas, the rated short-circuit current has been increased from 63kA to 80kA, which puts forward new requirements for the improvement of the breaking performance of the existing 550kV circuit breakers. In order to develop the arc chamber of 550kV 80kA circuit breaker and analyze the influence of different opening characteristics on the breaking performance, this article is based on the existing mathematical model of the arc breaking process of circuit breakers, and analyzes the breaking process under the two opening characteristics of 230mm and 260mm. A simulation calculation was carried out. The pressure of the arc extinguishing chamber during the breaking process is obtained, and the air flow field parameters such as the pressure, temperature and axial velocity of the arc extinguishing chamber at the current zero time are obtained. The breaking performance of the interrupter at two opening speeds is compared, which lays the foundation for the subsequent optimization design. Through analysis, it is found that in the breaking process, compared with the 230mm case, the 260mm case has a stronger breaking performance. Therefore, increasing the travel and increasing the opening speed, especially the opening speed near the current zero-crossing moment, can effectively improve the breaking performance of the circuit breaker, which provides a reference for the subsequent structural optimization design and travel characteristics matching of the interrupter.

P158

18:15-18:30

A multiple time-scales based multi-state co-estimation method for lithium-ion battery

Authors: Shiyi Fu, Taolin Lv, Jingying Xie, Lei Wu and Chengdong Luo
Presenter: Shiyi Fu, Space Power Technology State Key Laboratory, Shanghai Institute of Space Power-Sources, Shanghai, China

Abstract: As the core power source of electric vehicles (EVs), the lithium-ion batteries are supposed to work in safe and efficient condition, and an effective and stable battery management system (BMS) is the premise. In order to assure the batteries are working in an appropriate condition, the BMS need to be designed with the capability of monitoring the working information and internal states of battery. In this paper, considering the variation characteristics of the state of charge (SOC), the state of health (SOH) and the state of power (SOP) at different time scales and the coupling relationship between them, a multiple time scales based multi-state estimation method for lithium-ion batteries is proposed. First, an integrated model-based SOC estimation method is used for real time battery parameters identification and SOC estimation. Second, the capacity is estimated in a large time scale based on the combination of coulomb counting method and the SOC estimation method. Then, on the premise of knowing the internal parameters and states of the battery, the instantaneous peak charge/discharge power and continuous charge/discharge power are estimated under a variety of constrains. Finally, the urban dynamometer driving schedule (UDDS) test is carried out for verification. Results show that the proposed method can estimate battery states in high accuracy.

P223

18:30-18:45

Research on Reactor Vibration Based on COMSOL

Authors: Yuan Zhou, Tian Tian, Xiongfei Yu, Ran Ren, Liangcai Zhou, and Qiong Yang
Presenter: Changjian Xu, Chongqing University, China

Abstract: Due to the serious electromagnetic vibration problem of the reactor in operation, through the use of COMSOL finite element simulation software, on the basis of related theories, a three-phase in the multi-physical field coupling transient electromagnetic field and structural force field is established in COMSOL. The simplified model of the shunt reactor is used to simulate the magnetostrictive displacement and Maxwell force displacement produced by the iron core reactor during operation. According to the result of the displacement of the iron core obtained by the simulation, the magnetic field distribution in the iron core and the displacement distribution of the iron core deformation are further analyzed.

Session 5: Microgrid Control and Operation Management

Time: 16:30-18:45, Dec. 18, 2021, Beijing Time, GMT+8
Session Chair: Assistant Professor Heng Zhang, Shanghai Jiao Tong University, China
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P116

16:30-16:45

Research on System-Friendly Optical Storage DC Microgrid Sending-Out Control Strategy via MMC
Authors: Yang Baoxin, Wei Yitao, Zeng Qiwu, Xu Jianyuan, Zhang Fan and Huang Minghao
Presenter: Zhang Fan, Shenyang University of Technology, China

Abstract: For the grid-connected operation of optical storage DC-microgrid, a system-friendly control strategy of optical storage DC-Microgrid is proposed. During the period of low voltage, the traditional photovoltaic works in MPPT state, and the energy storage works in constant voltage control method, which keep the DC bus voltage stable; When the energy storage approaches the limit while the bus voltage still can't be controlled, the photovoltaic needs to switch the operation mode. The method described in this paper is to control the DC voltage through the MMC at the outlet end of the optical storage DC microgrid. The output power of photovoltaic and energy storage is controlled by flexible control method, and its crossing ability is verified by RT-LAB. The experimental results show that when the AC system is 0.5 p.u., the control strategy can still enable the Photovoltaic cell to generate fully power, maintain DC voltage stability, and send reactive power to the grid to maintain network voltage, which verifies the effectiveness of the control strategy.

P95

16:45-17:00

Distributed Real-time Energy Management of Multi-microgrid for Incomplete Information Scenarios
Authors: Jiahui Ma, Yanjun Li, Ji Xiang and Bo Zhao
Presenter: Jiahui Ma, Zhejiang University, China

Abstract: The interconnected microgrids in a certain area would meet power supply demands in the area through internal energy transactions. Due to the uncertainty of renewable energy output, forecast error will affect the economics of operation. This paper develops a distributed real-time dispatching strategy for multi-microgrid to avoid the large error from a long time forecast. Aiming at main difficulties of real-time scheduling of energy storage systems, a variable cost model is proposed. Each microgrid exchanges information of tradable energy and trading price with its neighboring microgrid and optimizes output of local components and adjusts the selling price to minimize the local cost. A modified alternating direction method of multipliers (ADMM) algorithm is presented for the optimization problem. Numerical results of a 3-MG system demonstrate the advantage of this dispatching strategy in incomplete information scenarios which including inaccurate predictions and communication interruptions.

P245

17:00-17:15

Coordinated dispatch of combined heat and power microgrid based on the improved sparrow search algorithm
Authors: Lei Xia, Jin Gao, Qinglong Liao, Xingui Yue, Hong Xiang, Xiaodong Wu, Xiao Tan
Presenter: Lei Xia, Electric Power Research Institute of State Grid Chongqing Electric Power Company, China

Abstract: In the context of the "dual-carbon" strategy, to improve the efficiency of the Micro-grid combined heat and power (MCHP), this paper proposed a multi-objective

optimization scheduling model based on an improved sparrow search algorithm. First, with the goal of the lowest comprehensive operating cost and the lowest environmental pollutant discharge, the economic benefit objective function and the environmental benefit objective function are established respectively. Then, a dynamic adaptive weight is introduced instead of a single weighting algorithm, and the sparrow search algorithm is integrated to establish a multi-objective optimal scheduling model for comprehensive energy. Finally, taking a typical daily operation as an example, different optimization scenarios are set to verify the proposed scheduling optimization model. The result shows that the multi-objective setting can better meet the power grid dispatching requirements than the single-objective setting. The optimization algorithm proposed in this paper can further improve the economic and environmental benefits of the integrated energy system.

P152

17:15-17:30

Tie-line power control of islanded microgrid cluster based on coordinated operation of thermostatically controlled load and battery

Authors: Zhixing Liu, Hua Fan, Chengxiong Mao, Dan Wang and Zixia Sang
Presenter: Zhixing Liu, Huazhong University of Science and Technology, China

Abstract: Renewable energy generation brings challenges to the stable operation of microgrid and microgrid cluster due to the randomness and intermittence of renewable energy. However, the use of traditional energy to assist operation leads to more cost and environmental pollution. This paper investigates a tie-line power control strategy of islanded microgrid cluster based on the coordinated operation of thermostatically controlled load (TCL) and battery without any traditional energy, which is mainly divided into two aspects: fluctuation suppression and energy scheduling. In the step of fluctuation suppression, the power fluctuation is divided into high-frequency and low-frequency component. The air conditioning power is controlled by TCL control algorithm to smooth the high-frequency component. Then eliminate the low-frequency component in the tie-line power by controlling the energy storage (ES) device. In the step of energy scheduling, this paper advances a suit of energy scheduling strategy with completely renewable energy supply, so that islanded microgrid cluster stably operates in a certain period of time through coordinated control.

P135

17:30-17:45

DC Impedance Stability Analysis of DC Microgrid Supplying Power to Passive Network

Authors: Yitao Wei, Baoxin Yang, Jianying Zhong, Qiwu Zeng, Jianyuan Xu, Gaole Yu
Presenter: Gaole Yu, Shenyang University of Technology, China

Abstract: In the process of DC microgrid that supplies power to the passive network, the DC impedance of the inverter on the passive network side presents a negative impedance characteristic, which affects the stability of the system. Aiming at this problem, a DC impedance optimization control strategy is proposed. First, the typical topology and basic control methods of the DC microgrid that supply power to the passive network are introduced. Then, the DC impedance models of the converters at both ends are established respectively, and the reasons for the insufficient stability margin of the DC system are analyzed and put forward DC impedance optimization control strategy. Finally, the effectiveness of the proposed control strategy is verified by the controller hardware-in-the-loop experiment. The experimental results show that the proposed method can reduce the fluctuation of DC voltage, avoid the converter output power oscillation, and enhance the stability of the system.

P61

17:45-18:00

Topology Adjustment and Optimal Flow Power Based Power Control for Offshore Wind Power

Authors: Jintao Yan, Lingling Huang, Feixiang Ying, Qiguo Wang, and Yang Liu
Presenter: Jintao Yan, Shanghai University of Electric Power, China

Abstract: With the cluster and scale development of offshore wind power, it has become an indispensable power source for onshore power grids, and thus onshore power grids have put forward higher requirements for the relatability and scheduling of offshore wind power. In this paper, we consider the latest trend of offshore wind power cluster development forming offshore wind interconnection system, and consider the offshore wind interconnection system interconnecting with onshore grid through multi-point grid connection, and study the research of achieving power optimization of offshore wind power multi-point grid connection in offshore wind interconnection system. An offshore wind power optimization model with the optimal tide of the onshore grid as the objective and topology adjustment as the control quantity is developed and solved using the interior point method. Simulation analysis of the improved IEEE39 node system and the offshore wind interconnection transmission system is carried out. The results of the algorithm show that this paper can effectively control the power optimization of offshore wind power between the grid connection points by using the topology adjustment method, to effectively improve the distribution of the onshore grid, meet the power demand of the onshore grid, and improve the reputability of offshore wind power.

P42

18:00-18:15

Model Prediction Control Scheme of Wind Farm with Energy Storage for Frequency Support

Authors: Shumin Sun, Peng Yu, Yan Cheng, Shibai Wang, Yuejiao Wang, Zhihao Zhang, Peng Kou
Presenter: Zhihao Zhang, Xi'an Jiaotong University, China

Abstract: The flexible control characteristic of energy storage system makes it have an advantage in participating in grid frequency regulation. The combination of wind power and energy storage has the effect of synergistic enhancement in providing frequency support. However, traditional PID controllers are difficult to achieve coordinated control of wind farms and energy storage. To address this issue, a model predictive control (MPC) based scheme of wind farm with energy storage system for frequency support is proposed. The MPC controller optimizes the power reference for each offshore wind turbine as well as the energy storage system, with the objective of minimizing the grid frequency deviation. In the MPC design, power constraints for wind turbines that adapt various wind speeds are considered, thereby ensuring the stable operation of wind turbines during the frequency support. Meanwhile, state of charge (SoC) constraints for the energy storage system is also proposed to extend its life. What's more, the moving horizon estimation (MHE) is introduced to estimate the grid power imbalance. The results show that the proposed scheme can effectively improve the performance of the grid frequency.

P199

18:15-18:30

Optimal Scheduling of Combined Heat and Power Units with Distributed Heat Pumps

Authors: Yanjuan Yu, Kena Wu, Qixing Shang and Guodong Li
Presenter: Yanjuan Yu, Naval University of Engineering, China

Abstract: The heat pump (HP) has been recognized as the promising device to cooperate with the combined heat and power (CHP) units for better wind power integration in the combined heat and power system (CHPS). This paper investigates the optimal scheduling strategy of the CHP units with the HPs which are distributed at heat exchange stations (HES). In consideration of the thermal inertia of the district heating system (DHS), the method for controlling the on-off status and running power of the HPs is proposed. Finally, the optimal scheduling model of the CHPS is established. The excellent performance of the HPs on reducing wind power curtailment is verified with numerical studies.

P133

18:30-18:45

Optimal Scheduling of Virtual power plants utilizing Wind power and Electric Vehicles

Authors: Syed Asad Abbas Rizvi, Ai Xin and Arsalan Masood
Presenter: Syed Asad Abbas Rizvi, North China Electric Power University, Beijing, China

Abstract: Increasing share of wind power in exponential rise of distributed energy resources utilization for cleaner energy is hindered by it's intrinsic haphazardness and lack of precise forecast. Virtual power plants (VPP) are often touted as the key part of future power system as it helps in mitigating the sporadic nature of distributed energy resources. This research study proposes the combination of wind farms and electric vehicles (EVs) as a VPP. EVs are proposed to act as the storage system of this VPP which can mitigate the intermittency of wind power. The utilization of EVs as storage system saves the initial investment cost of the VPP for establishing a specified storage system. The mobility and frequent connectivity of EVs to the grid are also the added advantages. A linear programming optimized model is proposed for optimal scheduling of VPP for participating in the day-ahead market. An innovative payment strategy for participating EVs is also proposed in this study. The whole proposed strategy is tested with a case study in the end.

Session 6: Electrical Engineering and Automation

Time: 16:30-18:45, Dec. 18, 2021, Beijing Time, GMT+8
Session Chair: Prof. Yongchun Liang, Hebei University of Science and Technology, China
Zoom Link: https://zoom.us/j/96750228536?pwd=d2hGWW9uekVqL0Z6K1YvYmtwVHhPQT09
Password：121820

P186
16:30-16:45

Intelligent Emplacement System of Electrical Switchgear Based on Information Fusion form Multi Sensors and Three-Dimensional Modeling
Authors: Chenyu Cao, Hong Wu, Yongbin Zhou, Zonglin Zhu, and Kai Li
Presenter: Kai Li, Tongji Zhejiang College, China

Abstract: Nowadays, the integration of informatization and intelligence abilities into the process of various kinds of infrastructure construction. As being inseparable from the construction of power grid system in any geographical area, power system is an important basic infrastructure and its informatization and intelligence level should even be emphasized. To be specific, switchgears play a core role in the power system, however, at present, their installation process can still be recognized as a type of “labor-intensive” work, which means that in most cases, they can only be handled and installed manually, and even a very little carelessness in these processes might cause great personal safety and property losses. Till now, few scholars have put forward their views on the emplacement of switchgear in the construction stage of power system. In this paper, based on multi-sensor data fusion and three-dimensional (3D) modeling technology, the intelligent emplacement method of electrical switchgear has been studied, and a set of effective installation scheme has been put forward, which can not only solve the problems of operation safety and efficiency in manual construction, but realize the effective monitoring of the whole process of construction and installation as well, so that the emplacement process can be traced, and the confusion phenomenon of on-site construction can be greatly reduced.

P03
16:45-17:00

Study on impedance characteristics of moisture ingress in cable joint and its detection method
Authors: Ying Yu, Yunpeng Di, Qishen Lv, Lin Zhang, Penglei Xu and Yincheng Gao
Presenter: Yunpeng Di, Xi’an Jiaotong University, China

Abstract: Cable joint is one of the most vulnerable parts of power cables. Moisture ingress with joints is a common defect of medium-voltage cross-linked cables. If not repaired timely, it will develop into premature failure of cable. This paper studies the impedance characteristics after moisture ingress into cable joints and their detection method. Based on the theoretical knowledge of time domain reflectometry (TDR), the three-dimensional model of single-core 10kV cold-shrinkable cable joint is established in the computer simulation technology (CST) Studio Suite to investigate the impedance characteristics and reflected waveforms of the joint under different moisture degree. Secondly, the moisture defects are made on the joint of the middle part of the 10 kV XLPE cable in the laboratory, and the S parameter measurement of joint and time-domain pulse reflectometry experiment are carried out respectively. Finally, the simulation and experimental results of impedance characteristics of moisture ingress on cable joint are analyzed and compared, and the field experiment proves the feasibility and effectiveness of using TDR to diagnose defected joints due to moisture ingress.

P181
17:00-17:15

Research on the Power Purchasing Strategy and Its Economics of Provincial Power Grid Adapting to New Energy Access
Authors: Donglin Xie, Fu Hu, Minqi Huang, Yahui Liu, Shaowei Duan, Xiafei Tang
Presenter: Shaowei Duan, Changsha University of Science and Technology, China

Abstract: In the future, large-scale new energy access to power grid has become an inevitable trend. Optimizing the power purchase strategy in the case of new energy access is an important measure to improve the economics of power grid operation. In this paper, the goal is to solve the most economical power purchase plan of power grid companies, and a provincial power grid power purchase cost model is constructed. This article models the power purchase situations from two aspects, which are the uncertainty of new energy power generation and the penetration rate of new energy. Then, establish a power purchase decision model with the minimum average power purchase price as the objective function. Finally, rationally use strategic behaviors for different power purchase situations, and reduce the average power purchase price to the lowest when the constraints are met. Through the above, a feasible economic plan is provided for power grid companies to formulate power purchase strategies.

P91

17:15-17:30

Impedance Measurement Method Based on Transient Disturbance Data Elimination and Data Recombination

Authors: Li Shupeng, Wu Bin, Liu Yali, Li Zhenbin, Nie Linwei, Cen Baoyi
Presenter: Cen Baoyi, CET Electric Technology Inc., China

Abstract: One of the key issues to be solved in system impedance measurement is how to separate the variations caused by the load from those caused by the system is . In this paper, a novel impedance measurement method based on linear regression has been developed, combined with transient data filtering, data combination and data selection. The technique of transient filtering is used to select the steady-state data for satisfying the assumption that the system must be in a stable state. The error caused by system fluctuation is minimized by data combination. Date selection is further used to improved the reliability of the results. Field test results show that the proposed noninvasive method is practical and robust so that it can be used with confidence to determine the system impedance.

P148

17:30-17:45

Optimal Simulation Research of MEMS Electric Field Measurement Sensor Based on Piezoelectric–Piezoresistive Coupling

Authors: Ye Yuanhao, Wang Tingting, Luo Bing, Zhou Jinhui, Song Guoliang, Wen Yonghua
Presenter: Ye Yuanhao, Foshan University, China

Abstract: To improve the accuracy and bandwidth of electric field measurement, and solve the problems of large size and high cost of current electric field measurement equipment. Based on the Piezoelectric–Piezoresistive coupling mechanism, this paper constructs a physical model of the MEMS(microelectro-mechanical systems) miniature electric field measurement sensor device. Through finite element simulation calculations, the strain changes of piezoelectric materials and semiconductor membranes of different sizes are studied and compared, and it is found that: The micro-sensors with 400μm side length and 350μm thickness of piezoelectric materials, 20μm thickness and 500μm side length of semiconductor membrane can be used to measure the electric field, which provides a certain reference for the measurement of electric field and the development of electric field measurement sensor.

P187

17:45-18:00

Unmanned Intelligent Installation for Indoor Power Electrical Equipment Based on Machine Vision and Internet-of-Things

Authors: Chenyu Cao, Xiaoli Yao, Xiaobo Jiang, Yuqing Liu, Kai Li
Presenter: Kai Li, Tongji Zhejiang College, China

Abstract: The construction and installation of indoor power electrical equipment is an important part of the power system industry. The equipments which need to be installed are often of huge mass and high precision, but the installation processes of them still

depend on manual completion. Thus, it is of great significance to build intelligent terminals and Internet-of-Things (IoT) platforms for indoor power electrical equipment and electrical system installation by employing various existing emerging information and communication technologies (ICTs). Relying on the current background of the rapid development of ICT, this paper integrates machine vision and IoT technology into the installation process of indoor power electrical equipment, and designs a set of indoor electrical equipment installation solution based on cloud online decision-making, edge computing aided remote data processing and monitoring, and intelligent machine on-site high-precision operation. Key functions such as safety collision avoidance and system communication scheduling logic are designed in detail. The designed system will greatly fill the gap of intelligence in the field of equipment installation engineering in the current power industry.

P163

18:00-18:15

Life Cycle Cost-benefit Measurement Model of Electric Vehicle AC Charging Piles in Residential Communities

Authors: Liang Yanni, Wu Liangzheng, Zhang Jigang, Wen Shangyong, Wang Ran
Presenter: Liang Yanni, Energy Development Research Institute, China Southern Power Grid Guangzhou, China

Abstract: To implement the emission peak and carbon neutrality, and promote the construction of "new infrastructure, new urbanization initiatives and major projects", power grid companies are actively exploring the development of electric vehicle charging service business. As far as they increase the investment in charging infrastructure in response to the national strategy, it is particularly important to improve the environmental and economic benefits of charging infrastructure at this stage. This paper establishes a life-cycle cost-benefit measurement model of electric vehicles AC charging piles in residential communities. According to the input parameters, the model simulates the life-cycle CO2 emissions of the generation side, the life-cycle net income of AC charging piles in residential communities and the impact of AC charging pile loads on the grid. The empirical results show that the life-cycle cost-benefit measurement model can guide the realistic investment-construction-planning of AC charging piles, which can improve the environmental and economic effects of grid companies.

P182

18:15-18:30

Thermal Power Capacity Price Seletction Mechanism

Authors: Zhang Li, Liao Jing, Wen Ming, Liu Hang, Tang Liang, Zhang Jiamin
Presenter: Tang Liang, Changsha University of Science and Technology, China

Abstract: In response to the country's low-carbon and sustainable development policies, it has become an inevitable trend that a high proportion of new energy sources will be connected to the grid in the future. New energy power generation is shifting from the role of supplementary energy in the power system to the role of alternative energy. With a high proportion of new energy sources connected to the power grid, in order to ensure the sufficient power supply of the system, thermal power companies will no longer continue to generate high-load power generation in the future, but will undertake the task of peak regulation and system balance. In order to enable thermal power companies to recover costs, obtain profits and encourage investors to invest when a high proportion of new energy sources is connected to the grid, this paper establishes a capacity market mechanism to calculate capacity electricity prices. This article selects the capacity percentage and then selects the capacity price from the two aspects of different percentage of capacity electricity price and real-time electricity price. Finally, this article combines the percentage of profitability of thermal power plants to calculate the capacity electricity price that enables thermal power companies to recover costs and obtain profit.

P28

18:30-18:45

Design of a 3D Reconstruction System with Automatic Correction Function

Authors: Ya Gao, Yi Gao, Qinling Zhu, and Bo Tan
Presenter: Ya Gao, Xi 'an Technological University, China

Abstract: In view of the problem that it is difficult to prepare for measuring the external dimensions of materials after heat treatment such as extrusion, stretching and straightening in factories, which is not conducive to further processing of materials in the later period, this paper designs a 3D reconstruction system which can quickly scan and reconstruct materials, obtain the deformation of materials, and measure the dimensions such as edge distance and surface flatness of materials. It can not only realize the continuous reconstruction of three-dimensional system of single material and the automatic reconstruction of starting and stopping root material by using the presence or absence of monitoring sensor of material in on-line non-stop state; At the same time, the basic size, deformation size and smoothness parameters of the reconstructed model are calculated In order to calibrate the center position deviation of materials with different sizes, reduce the influence of position information on the dimensional accuracy of material reconstruction, and increase the automatic correction function of center position. This design can supervise and feedback the processing effect of materials processing, and provide effective data reference for the further processing of materials and the reasonable combination of processing procedures. This design can improve the automation degree of processing and the quality of processed materials.

Session 7: Integrated Energy System

Time: 9:00-11:45, Dec. 19, 2021, Beijing Time, GMT+8
Session Chair: Senior Lecturer Tengku Juhana Tengku Hashim, Universiti Tenaga Nasional, Malaysia
Zoom Link: https://zoom.us/j/96203075575 Password：121820

P124

9:00-9:15

Analysis on Energy Demands and Load Characteristics of Industrial Parks Dominated Integrated Energy Systems
Authors: Simin Chen, Jinchun Chen, Han Chen, Wanqing Chen, Xiaofan Lin, Guannan Chen
Presenter: Simin Chen, Power Economic Research Institute of State Grid Fujian Electric Power Company, China

Abstract: Energy user characteristics of industrial parks play an important role in the design and operation of integrated energy systems. This paper investigates energy demands and load characteristics of industrial parks, public institutions, commercial buildings and residence communities in an integrated energy system dominated by industrial parks. Besides, the characteristics of different energy forms are analyzed in detail. The analysis results in this paper can lay a foundation for the study of comprehensive energy demand response of complex parks.

P10

9:15-9:30

Two-Stage Robust Optimization of Multi-Energy System Considering Integrated Demand Response
Authors: Yiming Yao, Chunyan Li, Kaigui Xie, Bo Hu, Changzheng Shao and Zhichao Yan
Presenter: Yiming Yao, Chongqing University, China

Abstract: High penetration of renewable energy, such as wind power, has brought threats to the security and reliability of power systems due to its uncertainty. To deal with hidden dangers of the imbalance of supply and demand, this paper proposes a model of integrated electrical, heating, natural gas and water distribution system. The price-based integrated demand response program has been formulated for the electrical, gas and water load. The thermal inertia of building materials is modeled to make full use of the thermal storage characteristic and provide a new means of heat demand response. Optimal schedule of the integrated demand response and the coordination among the multi-energy systems can promote the wind power accommodation and improve the operation cost. Considering the uncertainties of wind power and demands, a two-stage robust optimization method is developed, which can not only maximize the total profit but also make the system robust against the worst scenario. The proposed model is evaluated on an integrated test system to verify its correctness and superiority.

P45

9:30-9:45

Regional Integrated Energy System Optimization Method Considering Demand-side Response under Dual-carbon Goals
Authors: Hong Fan, Xinyi Bian and Shuxin Tian
Presenter: Xinyi Bian, Shanghai University of Electric Power and State Grid Changzhou City Jintan Electric Power Supply Company, China

Abstract: Under Chinese dual-carbon goals, access to high-permeability renewable energy leads to high risks for the operation of the power system, especially in extreme weather: blizzards, storms, earthquakes, tornadoes, etc. The safe and stable operation of the regionally integrated energy system is facing challenges. In extreme cases, how to realize the system scheduling of demand-side resource response, reduce the risk of system blackout, and restore the safe and stable operation of the system as soon as

possible is a scientific problem that needs to be solved urgently. First, it summarizes the realistic background and realization path of the dual-carbon goal. Second, it introduces the classification of demand-side response with the participation of new energy and the method of demand-side resource integration. On this basis, the optimization model and scheduling algorithm of the integrated energy system considering the demand response under the dual-carbon goal are proposed. Finally, the future development direction of the integrated energy system planning prospects.

P122

9:45-10:00

Design of Typical Application Scenarios for Integrated Demand Response in Multi-energy Collaborative System

Authors: Jinchun Chen, Simin Chen, Wanqing Chen, Han Chen, Xiaofan Lin and Guannan Chen
Presenter: Jinchun Chen, Power Economic Research Institute of State Grid Fujian Electric Power, China

Abstract: In order to meet the needs of diversified changes in modern energy supply systems and consumption patterns, multi-energy collaborative system (MECS) has become a trend in energy development. However, in view of the characteristics of multi-level architecture and multi-agent participation in multi-energy systems, there are still few researches on the integrated demand response (IDR) scenarios and specific response processes in the system. This paper considers the operating characteristics of MECS and the diversified functional positioning of integrated demand response. From the response target dimension, three typical application scenarios for IDR are designed to ensure the balance of energy supply and demand, improve user economy, and promote the consumption of distributed renewable energy. The form of subject participation and interactive behavior as well as response process of three typical application scenarios are analyzed. The three scenarios designed in this paper can provide references for the development of IDR of MECS.

P139

10:00-10:15

Day-Ahead Optimal Scheduling Method Of Park-Level Integrated Energy System Considering V2G Technology

Authors: Wei Wei, Lin Xu, Jierui Xu, Chang Liu, Dan Jin and Xueyuan Liu
Presenter: Jierui Xu, Southwest Jiaotong University, China

Abstract: Nowadays, electric vehicles with vehicle-to-grid (V2G) control are becoming flexible resources for power system dispatching and energy balance. It results in a significant impact on the economy of the integrated energy system operation. Considering the charging demand of electric vehicles and V2G control, a day-ahead scheduling strategy of the park integrated energy system is proposed in this paper. First, the model of EV charging station daily power demand is established, considering the influence of the initial charging time and the charging power. Second, with the goal of minimizing the operating cost, a collaborative scheduling model of the integrated energy system including the power grid and the natural gas network is put forward in this paper and solved by CPLEX solver. Finally, the scheduling strategy and economic benefits of electric vehicles are analyzed based on an actual park example. The simulation results show that the use of V2G control system can improve the operating economy of integrated energy system.

P107

10:15-10:30

Planning Method for Regenerative Electric Heating System Considering the Heat Load During Power Outage

Authors: Wanqing Chen, Xiaofan Lin, Yuanfei Li, Keren Chen, Guannan Chen, Han Chen, Simin Chen and Jinchun Chen
Presenter: Wanqing Chen, Power Economic Research Institute of State Grid Fujian Electric Power Company, China

Abstract: A two-layer planning method for regenerative electric heating considering the

heat load during power outage was proposed. Firstly, the model of regenerative electric heating system was established. Then, the heat load model during power outage was established. On this basis, the optimal planning model was proposed, which took the minimum daily operation cost as the objective function. Finally, a typical regenerative electric heating systems was used as a test system to illustrate the effectiveness of the method. The case results showed that the proposed method can effectively satisfy the heat load during power outage.

P138

10:30-10:45

Optimal Planning of Integrated Energy System Considering Photovoltaic Integration
Authors: Huanhuan Fang, Daifu Fan, Xingxin Jiang, Shuping Wang, Haozhong Cheng and Shenxi Zhang
Presenter: Shuping Wang, Shanghai Jiao Tong University, China

Abstract: Integrated energy system (IES) has advantages in improving the comprehensive utilization efficiency of energy, promoting the consumption of renewable energy and solving the problems of energy shortage and environmental pollution. An optimal planning method of IES considering photovoltaic (PV) integration is proposed in this paper. Firstly, considering PV units, the typical structure of IES containing electricity, gas, heat and cold energy is constructed, and the energy conversion and storage equipment are modeled; Then, aiming at the lowest total cost in the planning period, considering the constraints such as power balance, equipment working characteristics and upper limit of investment and construction, an optimal planning model of IES is established; Finally, an example is given to verify the effectiveness of the proposed method, and the effects of PV integration and natural gas price on the planning results are analyzed.

P75

10:45-11:00

Research on Comprehensive Demand Response Mechanism under Comprehensive Energy Service Mode
Authors: YI DU
Presenter: HAN CHEN, Power Economic Research Institute of State Grid Fujian Electric Power Company, China

Abstract: With the continuous acceleration of the construction of the energy Internet, the traditional demand response is developing towards integrated Demand response. Integrated demand response has gradually become a key technical means to enhance the flexibility of the demand side of the multi-energy coordinated system to ensure the safe, efficient and stable operation of the power system. It will also be an important business direction for the development of integrated energy services in the future. This paper focuses on the integrated Demand response incentive mechanism under the integrated energy service model. Firstly, the integrated energy service models are studied. Then, the composition of the main body of the integrated Demand response, the interest demand and the interest linkage relationship between the subjects are studied. Finally, a research model of incentive mechanism is established.

P125

11:00-11:15

Multi Rate Dynamic Hybrid Simulation of Integrated Energy System
Authors: Shaopu Tang, Shuqing Zhang, Siqi Yu, Xianfa Hu, Jianyun Zhang and Mingsong Liu
Presenter: Shaopu Tang, Tsinghua University, China

Abstract: Single rate digital simulation technology has been difficult to analyze the Integrated Energy System (IES) with wide time scale characteristics. The analysis of dynamic operation characteristics of IES needs the help of multi-rate dynamic hybrid simulation technology. In this paper, a dynamic multi rate hybrid simulation technology is proposed to realize the dynamic / transient simulation of IES, the interface method and interface interaction scheme of IES hybrid simulation is proposed. The hybrid simulation is realized through the case of IES, and compared with the single small step

simulation to verify the effectiveness of the hybrid simulation scheme.

P77

11:15-11:30

Optimal Energy Flow Calculation for multi-energy microgrid System Based on Interior Point Method

Authors: Haoting Wang, Qiong Wu, Hongbo Ren, Yanqi Wu
Presenter: Haoting Wang, Shanghai University of Electric Power, China

Abstract: With the closer coupling of power system and heat system, the analysis of multi-energy flow is become more and more import. Firstly, a unified objective function is constructed with the minimum supply cost. Then the optimal power flow model is established considering the constraints of unit output, coupling equipment operation and transmission line energy flow. Finally, based on the interior point method, the integrated energy system in the electro-thermal coupling area is selected for analysis and using MATLAB programming to solve the optimal energy flow. The comparison between ordinary energy flow calculation and optimal energy flow calculation shows that the optimal energy flow can achieve the minimum cost of overall system, and realize the optimization of power system, heat system parameters and unit output. The results of energy flow optimization verify the effectiveness of the interior point method.

P115

11:30-11:45

User-side Integrated Demand Response Business Architecture Based on Multi-energy Interconnection of Electricity, Heat and Gas

Authors: Han Chen, Simin Chen, Xiaofan Lin, Jinchun Chen, Wanqing Chen, Guannan Chen
Presenter: Han Chen, Power Economic Research Institute of State Grid Fujian Electric Power Company, China

Abstract: With the introduction of the integrated energy service strategy, the user-side integrated demand response (IDR) business has attracted more and more attention. This paper studies the corresponding business structure of the user-side integrated demand based on the multi-energy interconnection of electricity, heat and gas from four aspects. First, it analyzes the role positioning and characteristics of each business entity in theIDR from three aspects including function orientation, functional attributes, and business relationship. Next, it analyzes three business models of the IDR, i.e. engineering, investment, and operation. Then, the IDR business process is introduced from five links: IDR resource organization, IDR project management, IDR plan management, IDR plan implementation, and IDR incentive issuance. Finally, a user-side integrated demand response business structure based on the interconnection of multi-energy like electric, heating and gas is constructed from the aspects of the physical layer, information layer and control layer.

Session 8: Security and Reliability Analysis of Power System

Time: 9:00-12:15, Dec. 19, 2021, Beijing Time, GMT+8
Session Chair: Prof. Tomonobu Senjyu, University of the Ryukyus, Japan
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P170

9:00-9:15

ARIMA-LSTM Line Loss Anomaly Analysis Method Based on Wavelet Decomposition
Authors: Chengfei Qi, Tongjia Wei, Xiaokun Yang, Peisen Yuan
Presenter: Peisen Yuan, Nanjing Agricultural University, China

Abstract: One of the basic functions of power grid companies is to provide safe and reliable electrical energy. Line loss is a significant indicator for evaluating the performance of power transmission grids. It reflects the comprehensive capabilities of grid planning, operation and power enterprise management. Therefore, this paper proposes an ARIMA-LSTM line loss anomaly analysis method based on wavelet decomposition. First, wavelet transform is applied to decompose data to obtain high-frequency components and low-frequency components. Then we use ARIMA to predict the high-frequency components, and use LSTM to predict low-frequency components. Then wavelet transform is applied to reconstruct predicted values to obtain the predicted values of line loss data. Finally, the original data and predicted data are compared, and if the difference between the two is greater than the set threshold, it is consideredas abnormal. Experiments with real data sets show that the proposed method has a good anomaly detection effect.

P84

9:15-9:30

Evaluation on Factors Affecting System Reliability of Urban Distribution Networks
Authors: Yi Cao, Ping Liu, Qing Wang, Mingyu Han
Presenter: Yi Cao, Energy Development Research Institute, China Southern Power Grid Co., Ltd Guangzhou, China

Abstract: Distribution networks are directly connected to users and are the last mile of electrical power transmission. The reliability of the operation of distribution networks is directly related to consumer experience. The focus of distribution network planners is how to plan or reform the system to adapt to the access of new users and solve the problem of inadequate system reliability. At present, many different reliability analysis methods have been developed, all of which require calculations based on large amount of data. However, in the planning process, the critical points of a system can be found utilizing the regional reliability factors when the massive equipment data is unavailable. This improves the accuracy of network planning. Therefore, this paper proposes an approximate reliability evaluation theoretical formula based on the simulation analysis method, covering various influencing factors. The proposed formula calculates the derivatives of various factors, imports historical statistical data values, and finally quantitatively analyzes the degree of various influencing factors. A case study on a typical urban distribution network in China is conducted to demonstrate the effectiveness of the proposed method for identifying the key influential factors to system reliability.

P137

9:30-9:45

An improved hosting capacity assessment method for distribution network with DERs
Authors: Yaqiong Li, Shengjun Zhou
Presenter: Yaqiong Li, GEIRI, China

Abstract: High penetration of Distributed Energy Resources (DERs) may pose adverse impact on the distribution grid. Hosting capacity assessment, which calculates the maximum amount of DERs a distribution network can accommodate without raising reliability and power quality issues, is thus an effective tool providing support for DERs

integration management. To conquer non-convergence problem in hosting capacity calculation, this paper proposed a methodology which combined binary searching and stochastic DERs integration scheme generation. In addition, an empirical strategy is involved to raise the computational efficiency of stochastic scheme generation. Experimental results on a forty-node testing distribution network verified the merits of the proposed methods. The results evidenced the effectiveness of searching method and the integration of empirical scheme generation strategy.

P171

9:45-10:00

Dynamic State Estimation of Cyber-Physical Power and Energy Systems Based on Bad Data Identification

Authors: Shubo Hu, Shenghui Li, Xiaotong Zhang, Yangyang Ge, Zhengnan Gao and Baoshuo Sun
Presenter: Shubo Hu, State Grid Liaoning Electric Power Research Institute Co., Ltd, China

Abstract: Dynamic state estimation is an important approach to realize power network state perception in Cyber-Physical power and energy systems. However, more and more bad data are transferred into power grid energy management system because of data attack on transmission line or damage of measuring equipment. Meanwhile, as clean energy access to the power grid, the random nature of these sources leads to a large amount of fluctuating measurement data in the system, which is true data. The traditional robust Cubature Kalman Filter (CKF) method cannot distinguish bad data from fluctuating data. Fluctuating data are regarded as bad data, and the real characteristics of the data are lost. Based on the above deficiencies, a bad data pre-identification method based on big data is proposed, and improved robust volume CKF is conducted on each node of the Cyber-Physical power and energy systems. The innovation covariance based on the innovation sequence is calculated firstly and the measured variance with the total variance is compared to obtain the first-level identification; Secondly the correlation of the data according to the measurement sequence is calculated, and the secondary identification is conducted to distinguish the fluctuation data from the bad data. Simulation results show that the improved method can reduce the impact of bad data, while ensuring the authenticity of the measurement data, and improving the accuracy of state perception.

P207

10:00-10:15

An Abnormal Event Detection Method for Substation Monitoring

Authors: Jie Li, Licheng Sha, Helin Sun, Xiaolei Tian, and Lei Fu
Presenter: Jie Li, China State Grid Beijing Electric Power Company, China

Abstract: Aiming at the complexity of Substation Scene and the serious interference of electromagnetic noise and natural climate on foreground target detection, an intelligent identification system and method for abnormal event detection oriented to Substation Scene optimization are proposed. Combined with the substation monitoring objects and equipment, the abnormal condition monitoring strategy is designed. Based on the system architecture, combined with the improved Gaussian mixture background model and wavelet change principle, the abnormal target events are extracted and denoised. The spatiotemporal gradient model is used to improve the efficiency of anomaly target feature extraction, and the hidden Markov model is used to monitor the anomaly of surveillance video. Through field experiments and application verification, it is proved that the proposed method has higher accuracy and better detection effect than the traditional Gaussian mixture model method.

P47

10:15-10:30

Transient Temperature Rise Calculation for Power Cable in Ducts under Periodical Current

Authors: Chenzhao Fu, Yongchun Liang, Jiangya Wang, Ziyu Zhao and Yuanyuan Cui
Presenter: Jingya Wang, Hebei University of Science and Technology, China

Abstract: Transient temperature rise calculation is necessary for electrical engineers to obtain the accurate cable core temperature under cyclic current condition and manage power cable load. A lumped parameter transient thermal circuit model has been developed to evaluate the real-time transient temperature rise of the power cable in ducts. The temperature rise of each cable is divided into self-heating temperature rise caused by the heat in this cable and mutual-heating temperature rise caused by nearby other cables. Because it is difficult to calculate the value of thermal parameters in the lumped parameter model, all parameters are obtained with generic algorithm. The fitness function is the difference between transient thermal circuit analysis results and CYMCAP calculation results. The results obtained form the model agree with the accurate results obtained from CYMCAP well. It proved that the model can be used as a straightforward tool to calculate the transient temperature rise of power cable in ducts under periodical current

P83

10:30-10:45

Automatic Generation and Initialization of EMT Simulation models for Large-scale AC-DC Hybrid Power system

Authors: Zhihong Liu, Cuomu Yixi, Xiaoming Liu, Zihuan Huang, Zhendong Tan and Ying Chen

Presenter: Zhendong Tan, Tsinghua University, China

Abstract: High penetration of high voltage direct current (HVDC) and renewable energy increase power electronic devices in power grid, and it demands electromagnetic transient (EMT) simulation for power grid analysis and assessment. However, it is difficult to establish the EMT model of a large-scale power system with HVDC system. Determining start-up power flow of HVDC system and dynamic load is also difficult. Using the parameters of the corresponding electromechanical transient model, this paper proposes the approach for generating the EMT model of HVDC system and dynamic load. A smooth start-up method is also applied to determine HVDC system and dynamic load power flow start-up status. A large-scale practical power system with HVDC system is modelled in CloudPSS EMT simulation platform to test the proposed conversion and start-up method. The testing results confirm the transforming method and the start-up method.

P71

10:45-11:00

Research on the Distribution Characteristics of Mixed Ion Flow Field at Different Temperatures

Authors: Deigui Yao, Songyang Zhang, Zhongju Yang, Leilei Wang, Jingkai Nie, Fan Yang and Hao Yang

Presenter: Yang Zhongju, Chongqing University, China

Abstract: The electromagnetic environment under AC-DC parallel lines has become one of the main considerations in lines design. In this paper, the influence of temperature on the mixed ion flow field under AC-DC parallel lines is studied, the influence mechanism of temperature on the mixed ion flow field is analyzed, and the size of the mixed ion flow field at different temperatures is calculated. The results show that when the temperature increases from 0℃ to 25℃, the corona intensity of the line and the ion mobility increases, which makes the mixed ion flow field and the mixed ion current density under the line increase by 12.8% and 14.75% respectively.

P82

11:00-11:15

Research on bypass capacity test method of 1000MW FCB functional thermal power unit

Authors: Hong HU, Libin WEN

Presenter: Hong HU, Electric Power Research Institute of Guangxi Power Grid Co.Ltd, China

Abstract: A bypass capacity test method suitable for 1000MW FCB functional thermal power unit is proposed. Using the desuperheating water flow parameters which are

easy to obtain on site and with high accuracy, the bypass steam flow which is difficult to measure is calculated, so as to realize the accurate monitoring and real-time regulation of the bypass steam flow, and the obtained steam flow of the high-pressure and low-pressure bypass is converted into the corresponding flow under the initial steam parameters by using Friuli Greig Formula, which is compared with the main steam initial parameter flow standard to check whether the actual bypass system meets the functional operation requirements of the unit FCB. The calculation shows that this method is easy to implement and has high accuracy. It can improve the stability and economy of unit FCB operation through timely regulation of bypass steam flow, and has good application value.

P268

11:15-11:30

Fault Identification Method of Voltage Transformer Based on Time Series Hierarchical Clustering

Authors: Long Cheng, Wu Jie, Xiong Xingzhong, Chang Zhengwei, Luo Rongsen
Presenter: Wu Jie, State Grid Sichuan Electric Power Research Institute, China

Abstract: The measurement of voltage transformer is the basis of monitoring and control of power system, false measurement may result in malfunction of automatic device and erroneous decision of operator, therefore, it is quite important to identify voltage transformer fault timely. This paper proposed a fault identification method of voltage transformer based on multidimensional measurement data series, which can monitor all kinds of voltage transformer on line. Firstly, the empirical mode decomposition method is used to denoise voltage transformer measurement, thus eliminating the disturbance of bad data. Secondly, the time series hierarchical clustering method is utilized to analyze the measurement of multiple voltage transformer, thus identifying the faulted voltage transformer. Finally, the proposed method is applied to some practical case and is verified to be reasonable and valid.

P205

11:30-11:45

Fast Generation of Power System Operation Modes Based on Optimal Power Flow

Authors: Chang Li, Zhidan Wu, Li Dong, Min Liu and Yue Xiao
Presenter: Yue Xiao, Jinan University, China

Abstract: Power system operation mode (including power flow, unit generation, and load demand) is a snapshot of the power grid status and acts as the basis for the power-system-related analysis. Under the massive integration of variable renewable generation, fast generation of power system operation mode to describe the different status of a power grid is an essence for power system analysis. In this paper, we propose a framework for the fast generation of power system operation modes based on optimal power flow. Specifically, the framework includes these steps: randomly changing the current operation mode; establishing an optimal power flow model targeted for the smallest generator output change; adjusting the operation mode with non-convergence power flow into the feasible region. With the help of parallel computation, repeating the above steps to obtain a new operation mode will reduce the calculation time. A case study on the IEEE 14-bus system validates the effectiveness of the proposed method.

P85

11:45-12:00

Overview of Derating Factor Calculation Methods for Renewable Energy Capacity Mechanisms

Authors: Yi Cao, Qing Wang, Ping Liu, Mingyu Han
Presenter: Ping Liu, Energy Development Research Institute, China Southern Power Grid Co., Ltd Guangzhou, China

Abstract: Ensuring sufficient power generation adequacy is a requirement for the electricity system security and reliability. Many foreign power markets have introduced different types of capacity mechanisms such as centralized capacity markets and decentralized capacity obligations. The derating factor is one of the major design

elements of the capacity mechanism, representing the percentage of the installed capacity of the unit to characterize its effective capacity. Conventional power systems have a large number of thermal power plants and small system fluctuations, so the derating factor can be calculated easily based on historical data. With high penetration of renewable energy, renewable power generation contributes can significantly affect system adequacy and thus, should participate in the capacity mechanism. However, due to its stochastic characteristics, the calculation method of its derating factor needs to be studied again. This paper summarizes the relevant practical experience and academic research from the US and Europe in terms of renewable energy derating calculation, consisting of two major categories, i.e. historical data method and probability analysis method for comparative analysis. In addition, it analyzes the influence of the synergy effect caused by renewable energy on the derating factor, including the synergy effect between different power generation technologies, renewable energy and load. Finally, based on the status quo of the power market and carbon emission planning in China, feasible recommendations are put forward for the calculation of derating factors in China's adaptation to high-proportion renewable energy systems.

P273

A Method for Identifying Abnormity of Power Grid Voltage Measurement Based on Distance Correlation Coefficient

Authors: Hu Rong, Wu Jie, Li Shilong, Han Rui
Presenter: Wu Jie, State Grid Sichuan Electric Power Research Institute, China

12:00-12:15

Abstract: As an important front-end acquisition equipment for substation protection, control and measurement, voltage transformer's voltage transmission characteristics determine the accuracy of electricity charge measurement, the validity of substation voltage qualification rate and line loss rate calculation. In this paper, a method based on distance correlation coefficient is proposed to identify the abnormal state of voltage measurement in substation. At the same time, it can realize no power failure, no maintenance and no hardware installation. By using the existing grid voltage data, the slight abnormality of voltage transformer measurement can be found in advance, and the recognition accuracy can be improved.

Session 9: Fault Diagnosis and Detection

Time: 13:30-16:00, Dec. 19, 2021, Beijing Time, GMT+8
Session Chair: Prof. Qiushi Cui, Chongqing University, China
Zoom Link: https://zoom.us/j/96203075575 Password: 121820

P24 13:30-13:45

Flexible Arc Suppression Method Based on SOGI-FLL-PCI Controller and Fault Status Identification for Distribution Networks
Authors: Wen-qiang Cai, Mou-fa Guo, Ze-yin Zheng, and Hui Wang
Presenter: Wen-qiang Cai, Fuzhou University, China

Abstract: Active arc suppression device is proposed for arc suppression of single-line-to-ground fault in distribution networks. Different from the passive Peterson coil, it needs a reliable fault status identification method to realize the secure exit of the device as ground-fault arc is extinguished. To improve the self-healing ability of the distribution network, this paper proposes a flexible arc suppression method based on double closed-loop control and fault status identification, which directly controls the neutral point voltage of distribution network. The reignition of fault arc can be suppressed by flexible arc suppression device (FASD). Through actively reducing the neutral point voltage, the ground-fault resistance is calculated to identify fault status after FASD is put into operation. The purpose of the reliable exit of FASD can be achieved. In the meantime, a double closed-loop controller based on second-order generalized integrator frequency-locked loop and proportional complex integral is designed, which can adaptively track the grid frequency and effectively limit the ground-fault current and voltage. The simulation results verify that the method can realize quick suppression of fault arc and reliable exit of FASD under different types of SLG fault.

P27 13:45-14:00

An Alarm And Fault Association Rule Extraction Method for Power Equipment Based on Explainable Decision Tree
Authors: Yiying Zhang, Pengkai Wang, Kun Liang, Yeshen He and Shengguo Ma
Presenter: Huiying Qu, Tianjin University of Science and Technology, China

Abstract: For the widespread alarm logs in power generation and communication network equipment, it is difficult for professional maintenance staff to locate the alarm cause and remedy equipment faults. In terms of this issue, we propose an alarm-fault rule extraction method based on explainable artificial intelligence technology. We use an alarm time sequence diagram to express alarm information and build explainable alarm statistical features, and the important features are selected based on the weight random forest algorithm. Then we use the different combinations of important features to build a series of decision trees, which is understandable. We use this method to study the association rules between alarm and fault of synchronous digital hierarchy optical communication equipment in the power system. Experimental results show that this method is effective and reliable, thus provide an effective method for intelligent analysis of alarm logs and fault location.

P46 14:00-14:15

Research on OvervoltageFault Monitoring and Recognition System of the Distribution Network Based on Edge Computing
Authors: Xufei Zhang and Weili Wu
Presenter: Xufei Zhang, XI'AN UNIVERSITY OF SCIENCE AND TECHNOLOGY, China

Abstract: Given the shortcomings of the traditional distribution network overvoltage protection in terms of delay, this paper adopts edge computing to improve the effectiveness of the distribution network overvoltage early warning identification. First, the various functional modules of the Power Distribution Internet of Things (PD-IoT) based on edge computing are determined. Secondly, this paper constructs the framework of the distribution network overvoltage online monitoring system based on edge computing, analyzes each unit's working principle in detail, and gives the function realization method. This paper selects the Hilbert-Huang transform as the overvoltage data analysis algorithm when extracting the overvoltage characteristic quantity. Finally, the data is collected, analyzed, and transmitted through the overvoltage online monitoring and recognition system, and then quickly determines the fault point and provides a maintenance plan, which provides strong support for improving the power supply reliability of the power supply grid.

P106

14:15-14:30

Power Grid Fault Diagnosis Method Based on CNN
Authors: Yi Wang, XuZhang
Presenter: Yi Wang, North China Electric Power University, China

Abstract: With the development of digitalization of power grid, fault diagnosis of power grid is developing towards intelligence. The existing power grid fault diagnosis methods rely on experience to design the diagnosis model, lacking the ability to extract fault knowledge from the engineering field alarm information, and cannot achieve intelligent fault diagnosis quickly and accurately. To solve this problem, this paper proposes a fault diagnosis method for power grid based on alarm information text, using the deep feature extraction ability of convolutional neural network to realize end-to-end fault type discrimination and fault component location. Firstly, two models for fault classification and key information extraction are developed based on convolutional neural network. The fault classification model and the key information extraction model can extract the overall features and local features of the text respectively, identify the fault types, obtain the key information corresponding to the fault in the text, and screen the suspicious fault components. Then, based on the fault type discrimination results and key information output by two classification models, a component location strategy based on fault component characteristics is proposed. Finally, we use both highly descriptive and low-noise alarm information text generated by simulation and text with high noise and simplified description collected from engineering practice in fault diagnosis. The results show that the proposed method can realize end-to-end fault identification and fault components location.

P34

14:30-14:45

Current Quality Enhancement of PV String Inverter under Unbalanced Fault in Distribution Grid
Authors: Wei Zhang, Qilun Ao, Ming Zhong, Yuan Fan and Weiqi Meng
Presenter: Weiqi Meng, Tianjin University, China

Abstract: PV systems are increasingly connected to the power system, applying the increasing impact to the distribution grid, where single-phase sources and loads can lead to significant unbalance and cause significant interference to three-phase inverters. To ensure the proper operation of three-phase inverters, this paper studies the control system for string inverters under the unbalanced voltage and ensures the current quality. To control the positive sequence and negative sequence current simultaneously, a dual vector current controller is applied in this paper. The DC link voltage is controlled in the first stage. Besides, this paper uses a PI+R controller to reduce the second-order harmonic of DC link voltage. To verify the performance of these strategies, simulation results are provided.

P90

14:45-15:00

Research on Wind Turbine Gearbox Fault Diagnosis Based on CEEMDAN and CVFDT
Authors: Fangzhou Shi, Jianghao Yu, Min Gu, Kai Lei and Jian He
Presenter: Jianghao Yu, University of Electronic Science and Technology of China, China

Abstract: Gearbox fault diagnosis has always been a hot topic in the field of mechanical fault diagnosis and has great research value and significance. But at present, it is mainly based on offline data for fault diagnosis, which is not real-time and slow to find. In this paper, the real-time diagnosis of gearbox bearing fault is realized based on flow data. Aiming at the problems of nonstationary and weak fault characteristics of gearbox bearing vibration signals collected in real time, an energy entropy feature extraction method based on sliding window is proposed for adaptive noise complete set empirical mode decomposition (SW-CEEMDAN), which not only effectively solves the problem of end-point effect of CEEMDAN, The feature vectors containing rich fault features can also be extracted; Then, the incremental training and adaptive update of the model are carried out by combining the incremental classification method CVFDT, and then the gearbox fault diagnosis can be realized in real time. Finally, the validity of the improved method was proved by the bearing data set of Case Western reserve University.

P18

15:00-15:15

A simulation modeling method taking into account the quench characteristics of superconducting cables
Authors: Reheman Yushan, Renli Cheng, Xiaofeng He, Zhenzhe Zhang, Weizhe Ma, Zhe Zhang
Presenter: Reheman Yushan, Huazhong University of Science and Technology, China

Abstract: The quench characteristics of high-temperature superconducting (HTS) cable under grid fault conditions are complex and cannot be solved directly analytically. It is necessary to establish a simulation model of HTS cable which can reflect the quench characteristics.

According to the structural characteristics of HTS cable, this paper presents a method for calculating superconducting cable parameters based on branch model. The strong coupling relationship among the resistivity, critical current density and temperature of HTS tape after quench is analyzed, and the quench resistance calculation method based on cyclic iteration is proposed. On this basis, the simulation model of HTS cable which can reflect the time-varying characteristics of quench resistance is established by PSCAD software. Combined with the practical application case of HTS cable, the fault current, quench resistance and temperature variation characteristics of the system with HTS cable in short circuit fault are simulated and analyzed, and the effectiveness of the simulation model is verified.

P108

15:15-15:30

Research on Fault Diagnosis Method of DC Charging Pile Based on Deep Learning
Authors: Jinfeng Du, Wen An, Miaoxian Zhou, Wenlei Mao, Guangshan Huang, Shangyun Deng
Presenter: Jinfeng Du, Foshan University, China

Abstract: Aiming at the fault diagnosis of the charging module of the electric vehicle DC charging pile, a fault diagnosis method of the DC charging pile based on deep learning is proposed. First, through circuit simulation, the DC charging pile model is simulated under different faults and different working conditions, and the three input current signals are obtained as fault characteristic parameters. Perform three-layer wavelet packet decomposition and reconstruction of the fault characteristic parameters, calculate the frequency band energy spectrum data through the reconstruction coefficients, and normalize it. Finally, the fault characteristic set is composed of the fault data and the fault result, which is used as a deep neural network (DNN) Model input and verification. After the output layer of the constructed DNN model, a Softmax classifier is added to fine-tune the output fault characteristics and realize fault type recognition. Through the analysis of different types of faults of the charging module of the DC charging pile, the accuracy and effectiveness of the fault diagnosis method is verified, and its accuracy rate can reach more than 95.56%.

P202

15:30-15:45

Multi-dimensional Measurement Configuration for Risk Perception in Distribution Networks
Authors: Fan Wang, Bin Ding, Qiang Jin, Bo Zhang, Xu Yao
Presenter: Qiang Jin, State Grid Economic and Technological Research Institute Co. Ltd., Beijing, China

Abstract: In recent years, extreme weather disasters occur frequently in the global climate, which not only affects the sustainable development of the global economy, but also seriously threatens people's normal production and life. In order to ensure the sustainable power supply of important loads under extreme disasters, it is of great significance to timely perceive the risk of distribution network components. Therefore, this paper proposes a multi-dimensional measurement configuration method for distribution network to improve risk perception. Firstly, the multi-dimensional measurement data requirements of distribution networks are analyzed, and the measurement equipment is determined based on the data requirements. Secondly, the risk assessment method of distribution network component failure is proposed, and considering the economy and observability of measurement configuration and the improvement effect of different configuration schemes on the accuracy of risk perception, a method to improve the risk perception ability of distribution network is proposed. Finally, the identification method of key components of distribution network is proposed, and a multi-dimensional measurement optimization configuration method is proposed based on the identification results of key components, so as to improve the disaster loss identification ability of distribution network when the electrical measurement device fails.

P165

15:45-16:00

Series DC Arc Fault Detection in Photovoltaic System Based on Multi-feature Fusion and SVM
Authors: Pengpeng Chu, Zengxiang He, Kanjian Zhang and Haikun Wei
Presenter: Pengpeng Chu, Southeast University, China

Abstract: The photovoltaic (PV) system working environment, which contains a large number of interferences, is easy to produce series direct current (DC) arc. Aiming at the problems of poor anti-interference ability of time domain detection and difficulty in feature extraction, an arc fault detection method based on Hilbert spectrum analysis (HSA), singular value decomposition (SVD) and support vector machine (SVM) is proposed. By removing the DC component of the signal and ensemble empirical mode decomposition (EEMD), the influence of different loads and noises on feature extraction is overcome. The intrinsic mode functions (IMFs) are used to perform HSA

and SVD to obtain the maximum value of the Hilbert marginal spectrum and singular values, which add the maximum current change difference as the multi-feature fusion. The particle swarm optimization (PSO) is used to optimize the penalty coefficient c and the Gaussian kernel parameter g of SVM based on the constructed feature vector. It has been verified by experiments that it can achieve a better series DC arc fault detection effect.

Session 10: Renewable Energy Power Generation and Clean Energy Technology

Time: 13:30-16:00, Dec. 19, 2021, Beijing Time, GMT+8
Session Chair: Senior Lecturer Renuga Verayiah, Universiti Tenaga Nasional, Malaysia
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P25

13:30-13:45

Investigation of Power Flow Tracing Strategy Using an Index in a Transmission System with Solar PV for Congestion Management
Authors: Mohamad Razin Naim, Renuga Verayiah and Jun Yin Lee
Presenter: Renuga Verayiah, Universiti Tenaga Nasional, Malaysia

Abstract: Voltage stability indices (VSI) have been developed to solve for uncertainty and irregularities that occur beyond the boundary of a standard operating limit of the power system. Maintaining voltage at each bus are crucial to avoid blackouts which are mainly due to insufficient reactive powers especially when demand is high. Integration of distributed generation (DG) into the system can help improve the performance level, especially during congestion and heavy loading. This paper demonstrates the performance of LQP_LT in tracing the weak buses present in IEEE 14 bus system. Besides that, to test for the validity and reliability of the index, other VSIs are used, namely FVSI, NLSI and VLSI for performance comparison. MATPOWER cases were utilized for load flow analysis while simulations for the LQP_LT algorithm is done in MATLAB. Solar photovoltaic (PV) integration in IEEE 14 bus system is done considering for both base case and heavily loaded scenarios. Upon performance comparison of the indices, LQP_LT identified weak bus was verified using exact loss formula. This method is an approximation analysis that is used to determine the most suitable location for solar PV positioning and sizing. Both LQP_LT and exact loss method have a consistent outcome in identifying the weak bus. Solar PV sizing was further computed using the same exact loss formula and placed at the identified weak bus. The result obtained from the study shows that the LQP_LT index is robust and efficient to analyze the power flow present in the transmission system. The list of weak buses is arranged in descending order from highest to lowest index amount. Last but not least, PV placement with appropriate sizing at the identified weak bus greatly improved the overall system stability and losses.

P114

13:45-14:00

Risk Assessment Method of Offshore Wind Farm Integration System Considering Time-Varying Operating Conditions
Authors: Hong Guan, Yaonan Zhang, Lujie Liu, Xingang Yang, Boyuan Cao, Yang Du and Lingyu Guo
Presenter: Lujie Liu, Shanghai University of Electric Power, China

Abstract: Aiming at the problem of accurate assessment of the risk of wind farm integration system under complicated offshore operating conditions, this paper proposes a risk assessment method for offshore wind farm integration system considering time-varying operating conditions. First, combined with the historical operation and condition monitoring data of the offshore wind farm equipment, the fuzzy C-means clustering algorithm is used to classify the operating conditions of the wind turbines, and the maintenance factors and weather factors are introduced to consider the incomplete maintenance and weather under time-varying conditions. The failure rate models of key equipment in the offshore wind farm integration system are established. Then, according to the networking mode of the integration system, the power supply connectivity matrix of the integration system is established using graph theory, and the risk indicators of the offshore wind farm integration system are constructed. The Monte Carlo simulation method is used to conduct the assessment of

offshore wind farm integration system. Finally, taking an offshore wind farm integration system as an example, the effectiveness and accuracy of the proposed method are verified.

P155

14:00-14:15

Implementation of a Lab-Scale Green Hydrogen Production System with Solar PV Emulator and Energy Storage System

Authors: Harshal V. Patel, Saman A. Gorji, Shahrzad S. M. Shahi and Jonathan G. Love

Presenter: Saman A Gorji, Queensland University of Technology

Abstract: The aim of this research is to review, design, model and implement a green hydrogen production system by means of renewable energy sources. The proposed system is divided into three different power conversion stages: (a) renewable input power source: Photo-Voltaic (PV) emulator, (b) energy storage system: Li-ion battery, and (c) load: Electrolyser. A 600W PV emulator is connected to a 60Ah - 12V battery storage system via a Maximum Power Point Tracking (MPPT) DC-DC converter. It is then connected to a 300W electroyser through a 500VA -230V inverter. In conjunction with the proposed designed system, the system was modelled in MATLAB/Simulink alongside a lab-scale experimental setup. The results attained through the simulation and experiment were in a perfect match and the overall system efficiency was achieved as projected. The article's conclusion will help the new researchers to select a system that is sustainable for green hydrogen production.

P174

14:15-14:30

Research on scene generation method of wind and solar active power output based on k-medoids clustering and Generative Adversarial Networks

Authors: Rui Yu, Wei Hu, Hang Jiang, Xinyue Zhang, Fei He, Yudong Zhang, Minhao Lai

Presenter: Xinyue Zhang, Tsinghua University, China

Abstract: In recent years, wind power and photovoltaic power generation have developed rapidly, and the installed proportion of wind power and photovoltaic power will further increase in the future. Aiming at the strong uncertainty of wind power and photovoltaic power, a scene generation method of wind and solar active power output based on k-medoids clustering and generative adversarial networks is proposed to avoid problems of model convergence and gradient disappearance, meanwhile preserving the diversity of generated results. Using the active power output data of two wind power plants and six photovoltaic power plants in Western China for 365 days a year, the data samples are clustered into ten scenarios by k-mediods method, which are used as training sets under different typical scenarios.The distribution characteristics of active power output data are effectively fitted by the generative adversarial networks, and its generation effect is analyzed. The results show that the scene generation method of wind and solar active power output based on k-medoids clustering and generative adversarial networks has the advantages of fast convergence and high precision.

P50

14:30-14:45

Optimal Scheduling of Energy Storage for Power System with Capability of Sensing Short-term Future PV Power Production

Authors: Sarvar Hussain Nengroo, Sangkeum Lee, Hojun Jin, Dongsoo Har

Presenter: Sarvar Hussain Nengroo, Korea Advanced Institute of Science and Technology, South Korea

Abstract: Constant rise in energy consumption that comes with the population growth and introduction of new technologies has posed critical issues such as efficient energy management on the consumer side. That has elevated the importance of the use of renewable energy sources, particularly photovoltaic (PV) system and wind turbine. This work models and discusses design options based on the hybrid power system of grid

and battery storage. The effects of installed capacity on renewable penetration (RP) and cost of electricity (COE) are investigated for each modality. For successful operation of hybrid power system and electricity trading in power market, accurate predictions of PV power production and load demand are taken into account. A machine learning (ML) model is introduced for scheduling, and predicting variations of the PV power production and load demand. Fitness of the ML model shows, when employing a linear regression model, the mean squared error (MSE) of 0.000012, root mean square error (RMSE) of 0.003560 and R2 of 0.999379. Using predicted PV power production and load demand, reduction of electricity cost is 37.5 % when PV and utility grid are utilized, and is 43.06% when PV, utility grid, and storage system are utilized.

P59

14:45-15:00

Energy availability analysis of offshore wind farms considering the correlation between wind speed cloud model and parameters

Authors: Yuzhi Miao, Ling-ling Huang, Yang Liu, Feixiang Ying, Mingyang Song
Presenter: Yuzhi Miao, Shanghai University of Electric Power, China

Abstract: With the development of smart wind turbines, more comprehensive data and information for reliability assessment of wind turbines are provided. The reliability assessment can be carried out by statistically analyzing the failure and outage time of wind farm units, using simulation mathematical methods. However, for large-scale offshore wind farms, there is often the problem of a lack of wind farm data. Moreover, compared to wind farms, offshore wind farms operating in complex environments, harsh operating conditions for wind turbines, uncertain parameters, and complex coupling relationships among various uncertain parameters, which improve the energy reliability of offshore wind farms. Accordingly, in this paper, the offshore wind farm reliability assessment method takes into account the complex coupling effects of uncertain factors and parameters. In general, it mainly considers wind speed, ocean waves, own failure rate, and maintenance resource allocation plan method among climatic factors are mainly considered in this paper. For the main influencing parameters, the method of the cloud model is used to change the numerical state of multiple parameters, and the method of artificial neural network(ANN) and multiple linear regression is used to analyze the correlation between multiple parameters to explore the power-generation capacity of offshore wind farms. The degree of influence of the parameters of various uncertain factors. The proposed method is exemplified via an illustrative example of an offshore wind farm system and the influence and relationship between the power-generation capacity of the offshore wind farm by multiple parameters can be revealed clearly.

P98

15:00-15:15

Decision Trees Based Performance Analysis for Influence of Sensitizers Characteristics in Dye-Sensitized Solar Cells

Authors: Hisham A. Maddah
Presenter: Hisham A. Maddah, King Abdulaziz University, Saudi Arabia

Abstract: The focus of the scientific community has shifted towards renewable and sustainable natural photosensitizers for dye-sensitized solar cells (DSSCs). Here, we statistically investigate the possibility to achieve relatively high PCEs in naturally-sensitized-photoanode-based DSSCs using decision trees (machine learning). We studied the chemical structure and bandgap of 27 sensitizers, which were then correlated to the literature reported PCEs. Tree training was carried out via 4 (dye) predictors including the number of π-bonds (PI), the number of anchoring groups (X), HOMO(H)-LUMO(L), and bandgap energy (BG), with 2 responses regarding the statistical possibility to achieve high PCEs (Yes/No). Trained datasets revealed the controlling parameters responsible for increasing PCEs. Testing (future) datasets were chosen to check for built models' accuracy in performance prediction for enhanced charge injection (current density). This work shows the potential of natural sensitizers

used in DSSCs for renewable, cost-effective, and sustainable energy production.

P68

15:15-15:30

Research on Characteristics and Development Trends of Nuclear Power in East China
Authors: Jirong Huang, Qian Jiang and Xiu Yang
Presenter: Qian Jiang, Shanghai University of Electric Power, China

Abstract: In the 14th Five-Year Plan (2021-2025), East China will take the initiative to foster an advanced power system with renewable energy as the main body, aiming at energy consumption transformation as well as the goal of carbon peaking and carbon neutrality. Considering that East China is experiencing considerable energy shortage, nuclear power can undoubtedly facilitate the energy structure transformation as a stable power supply which is clean, flexible and energy efficient. This paper firstly introduces the current status of nuclear power generation in East China. Then advantages and disadvantages of developing nuclear power in East China are analyzed from perspectives of energy characteristics, generation cost and grid operation. After that, the influence of East China power supply and demand situation on nuclear power consumption is described in detail. Finally, opportunities of nuclear power development in East China are discussed. Challenges of inter-provincial power trading are also probed in view of difference in development pathways and competition in power market. Practical suggestions on future development of nuclear power in East China Power Grid are proposed from various aspects.

P175

15:30-15:45

Photovoltaic Modelling and Output Power Performance for Support of Power Consumption for an University Mosque
Authors: Rais Izzuddin Abdul Rahman, Tengku Juhana Tengku Hashim, Nur Azzamuddin Rahmat
Presenter: Tengku Juhana Tengku Hashim, Universiti Tenaga Nasional, Malaysia

Abstract: Malaysia has the most abundant resources for renewable energy. Due to its geolocation, solar energy has the highest concentration compared to other renewable resources. Harvesting electrical energy from these resources necessitates the use of newly developed renewable technologies such as wind turbine, solar panel and water turbine. In addition to being new, the technology has a low rate of power generation, making it unsuitable as a major energy source. Solar energy has been chosen as a source to help support the energy demand of an university mosque. In this work, Matlab/Simulink has been used to simulate the photovoltaic system and generate current against voltage (I-V) and power against voltage (P-V) graphs using mathematical modelling approach in order to measure the maximum point of the output data which is crucial for this research. Due to heat loss, the I-V graph indicates that current varies slightly as temperature rises, but voltage decreases and the P-V graph shows that when the temperature is low and the solar irradiation is high, higher power output is produced. The power output data was extracted and tested in different conditions and the percentages of the support power outputs obtained are within the desirable range for this study.

P57

15:45-16:00

A Supplementary Testing and Solution for The Incompetent Nozzles in The Servomotor of A Turbine Steam Governing Valve
Authors: Chuanxiang Jing, Tongming Jing, and Peng Guo
Presenter: Chuanxiang Jing, China Nuclear Power Engieering Co., Ltd, China

Abstract: In a nuclear power plant (NPP), there are rarely any testing or maintenance instructions about the nozzles in a servomotor of a turbine HP steam governing valve, except the dimension data stated in Equipment Operation and Maintenance Manual (EOMM). Not a sufficient level of sensitivity to foreseeable accident scenarios caused by the incompetent, small nozzles, is gained until the failure of transient tests on high loads or a turbine trip. For this issue, a supplementary testing and solution in the

functional tests with the unit shutdown, taking the Automatic Turbine Testing (ATT, i.e. the periodical full stoke activities of selected turbine valves on load) into consideration, is developed and turns out to be reliable and effective to disclose the mismatch among the target nozzles, EVS (Directional Security Solenoid Check Valve to force a fast-closing), and the Electro-Hydraulic Amplifiers (EHA), especially during the commissioning period of a newly built NPP with a new design. It is to identify the potential mechanical and control defects of the turbine steam valves with the greatest nuclear safety significance, for commissioning, operation & maintenance (O&M) groups.

Session 11: Energy Planning and Management

Time: 16:15-18:45, Dec. 19, 2021, Beijing Time, GMT+8
Session Chair: Assoc. Prof. Andrea Trianni, University of Technology Sydney, Australia
Zoom Link: Zoom Link: https://zoom.us/j/96203075575 Password：121820

P22
16:15-16:30

Towards a Framework Linking Industrial Energy Efficiency Measures with Production Resources
Authors: S M Monjurul Hasan, Minhal Raza, Mile Katic and Andrea Trianni
Presenter: Andrea Trianni, University of Technology Sydney, Australia

Abstract: Considering the ongoing significance of global warming and green-house gas emissions, energy efficiency has become one of the major instruments towards improved sustainability and industrial competitiveness. Extant literature has been addressing energy efficiency in the industrial context; however, a gap still remaining to discuss energy efficiency measures with production resources. Thus, this paper aims to propose a preliminary framework linking industrial energy efficiency measures to production resources. In this context, electrical motors in industrial environments are considered. The framework can play a key role in understanding the impacts of energy efficiency measures. The paper concludes with interesting future research avenues.

P43
16:30-16:45

A Study of Peak CO2 Emission Model on Regional Energy Consumption
Authors: Xianghai Xu, Xuan Yang, Xiaoxiao Zhao, Lu Gao, Jiayi Shang, Zhiyuan Chen and Zixun Zheng
Presenter: Zixun Zheng, Beijing SGITG Accenture Information & Technology Center Co., Ltd, China

Abstract: Thermal power generation and heating account for 44% of total CO2 emissions from energy-related activities. Therefore, it is particularly critical to achieve peak CO2 emissions in electricity generation as soon as possible. This study is aimed at modeling peak CO2 emissions from energy and electric power with power development planning and historical energy consumption data in Hangzhou, Zhejiang. The model is based on computation of CO2 emissions from coal, oil, natural gas and electricity. First, current status of energy production and consumption as well as related CO2 emissions in Hangzhou, Zhejiang are investigated. Secondly, model to forecast peak CO2 emissions in electric power is established with consideration of power generation planning, local Solar PV planning, proportion of renewable allocation electricity from other provinces, alternative energy, and installed capacity of energy storage. Finally, combined with forecast of peak CO2 emissions in electric power, forecast of peak CO2 emissions in energy is also performed considering GDP, population, energy structure, industrial structure and total energy consumption. With the forecast result, it is aimed to offer an approach in reduction of total energy-related CO2 emissions.

P117
16:45-17:00

Analysis of the business model of the rural Energy Internet platform
Authors: Zihao Tong, Jianing Wang, Erfei Hui and Wuliang Duan
Presenter: Zihao Tong, Economics and management of North China Electric Power University, China

Abstract: This paper divides the application scenarios of rural Energy Internet platforms into four aspects : smart care, smart heating, smart agriculture and smart industry and commerce according to market and user needs. Then the rural Energy Internet platform is used as an industrial form, and the business model canvas theory is used to analyze the service mode of the platform. The business model of the rural Energy Internet platform is analyzed from nine aspects: important partners, key business, core

resources, value proposition, customer relationship, channel path, customer segmentation, cost structure and income source. Finally, the future development and research are prospected.

P76

17:00-17:15

Research on Optimization Model of Electric Power Development Considering Multi-factor Constraints

Authors: YI DU
Presenter: HAN CHEN, Power Economic Research Institute of State Grid Fujian Electric Power Company, China

Abstract: In response to global climate change and energy stress, countries around the world have embarked on strategic initiatives to transition to a low-carbon economy and renewable energy.In recent years, all sectors of Chinese society have paid more and more attention to the energy transition.This paper firstly analyzes the current status and trends of Chinese energy and power development.Secondly the basic principles of power optimization layout are studied.Thirdly, multi-factor power optimization research ideas are proposed.Finally, a multi-factor power optimization model(MFPPM) is built.The research results provide an effective method for the national and provincial energy and power industries to carry out optimized power distribution, and help promote the energy transition.

P92

17:15-17:30

Low carbon economic dispatch of multi-energy combined system considering carbon trading

Authors: Hong HU, Libin WEN, Kun ZHENG
Presenter: Hong HU, Electric Power Research Institute of Guangxi Power Grid Co.Ltd, China

Abstract: A low carbon economic dispatch model of multi-energy combined system with wind power, photovoltaic, hydropower, thermal power, nuclear power, and energy storage is proposed, which takes into account carbon trading. Carbon transaction cost is used as the evaluation index of carbon transaction satisfaction, and take the low-carbon economy of the system as the optimization goal. A thermal power storage model for thermal power storage boilers and a flexible and adjustable nuclear power model witch ensuring safety were established on the power supply side. Considering the randomness, intermittence and fluctuation of wind power and photovoltaic power generation; refine the peak load regulation of thermal power units into ordinary and deep in order to refine their economic indicators. The results shows that the model is feasible in calculating the short-term optimization of the power system, can effectively reduce the carbon emissions of the power system, improve the level of new energy efficient utilization and the economy of the system. It also has good application value for realizing the low-carbon economic operation of the power system.

P69

17:30-17:45

Evaluation of the Development Maturity of Emerging Industry of Energy Internet Based on Entropy Weight Matter-element Model

Authors: Lin Liu, Chunming Wang, Wei Cui and Xi Kang
Presenter: Wei Cui, Beijing Information Science and Technology University, Beijing, China

Abstract: The emerging industry of energy Internet represents the direction of a new round of scientific and technological revolution and industrial change, and is the key to cultivate new drivers of development and gain new competitive advantages in the future. Based on the connotation, development direction and features of the emerging industry, this study designs 11 second-level indicators from 5 dimensions, including operation ability, innovation ability, social benefits, ecological benefits and information development, and constructs an entropy weight matter-element model for the evaluation of emerging industries' development. In addition, according to the theory of

industrial maturity, the development level of emerging industry is divided into five stages, namely, forming, initial, growth, maturity and maturity optimization. And a theoretical model of development maturity evaluation of emerging industry is constructed. Further, this study takes the indicators of energy + e-commerce industry in 2019 as an example to evaluate its development maturity. The results show that the development maturity of the industry in 2019 is in the growth stage, and the fixed asset investment and information level of core business need to be further improved. The research model in this study provides a certain research basis for the development maturity of emerging industry of energy Internet.

P197

17:45-18:00

Voyage Optimization for All-Electric Vessels Integrated With Swappable Containerized Battery

Authors: Mingchang Gu, Shuli Wen, Miao Zhu, Cixiang Chen, Yuqing Huang
Presenter: Mingchang Gu, Shanghai Jiao Tong University, China

Abstract: Owing to the increasing concerns over the pollution released by the traditional ships, full electrification of shipping provides significant opportunities to reduce carbon emissions. However, disordered navigation will lead to an undesired cost and increased greenhouse gas emissions. This paper proposes a mixed-integer linear programming based model to optimize the voyage scheduling and energy management for all-electric vessels with the use of swappable containerized batteries. Furthermore, the impacts of capacity of battery containers and the pricing strategy of battery swapping stations are considered. A navigation route in the real world with a total of six ports is employed to conduct case study. Simulation results demonstrate the efficiency of the proposed method and with the support of the proposed method, a safe and economic voyage-battery swapping strategy is achieved.

P334

18:00-18:15

A high proportion of new energy participates in the design of the day-ahead market clearing mechanism

Authors: Xuguang Zhang, Wen LU, Tianran Li, Chuhao Wang
Presenter: Xuguang Zhang , Nanjing Normal University, China

Abstract: New energy will become the main role of power market transaction in the new power system. It is necessary to establish fair and reasonable market mechanism for new energy participation, and ensure win-win benefits of all types of energy market subject under the premise of safe and reliable operation of power grid. Considering the large increase of the proportion of new energy in the future, this paper puts forward the design principles of new energy participating in the spot market, designs the spot market mechanism and market declaration, clearing and settlement compensation mechanism to promote the new energy consumption. Finally, the consumption of new energy, the change of system cost and the income of market entities are simulated under the condition of high proportion of new energy, The results show that compared with the forced replacement of new energy, the adoption of secondary clearing mechanism can promote the new energy consumption and reduce the operating cost of the system. The corresponding cost allocation is more fair and reasonable according to the market main body behavior.

P109

18:15-18:30

Intelligent Energy Planning and Design of Industrial Park under New Power System

Authors: Hongli SU, Zhifeng WEI, Mengjie ZHAO
Presenter: Hongli SU, Beijing SGITG Accenture Information Technology Center CO., Ltd.,China

Abstract: In the context of promoting the realization of the "double carbon" goal, the scale of new energy development is gradually expanding and the proportion of grid connection is becoming higher and higher. Industrial parks dominated by traditional thermal power supply urgently need to optimize the energy structure and layout of the

park, increase the proportion of clean energy, improve the terminal electrification level and utilization efficiency, and build a clean, low-carbon, safe and efficient new power system, Meet the diversified energy demand in the park. Focusing on "smart energy drives smart Park", this paper makes full use of advanced technologies such as "big cloud moving smart", focuses on basic sharing, digital interconnection, power substitution, coordination and interaction, carries out smart energy planning and design of Industrial Park, strengthens in-depth perception of terminal equipment, deepens big data interconnection, widely promotes comprehensive energy and smart energy use, and improves automatic data collection Support various intelligent business applications and promote the intelligent construction of industrial parks.

P66

18:30-18:45

The Feasibility of Economic Viability of Hybrid PV-Diesel Energy System Connect With the Main Grid in Somalia

Authors: Yonis Khalif Elmi, Moein Jazayeri, Diaa Salman
Presenter: Yonis Khalif Elmi, Cyprus International University, Turkey

Abstract: Somalia has abundant resources in renewable energy; however, more than 90% of the electricity uses diesel, which is imported from outside the country and causes temperature rise and high electricity prices. This study examined the feasibility of several hybrid systems in Somalia's capital city, including solar photovoltaic (PV), battery storage (BS), diesel generators (DG) and the main grid systems to minimize the levelized Cost of Energy (COE), Net Present Costs (NPC) and environmental impacts. Nine different system configurations were investigated, including stand-alone DG, stand-alone main grid system, Hybrid PV-DG with and without BS that connected to the main grid, Hybrid PV-DG with and without BS without connecting the main grid, Hybrid PV-Grid with and without BS system, and finally Hybrid DG-Grid system. Furthermore, the hybrid optimization model for electric renewables (HOMER) is applied to optimize and analyze sensitivity. The result found that hybrid PV-DG-grid without battery storage system is the cheapest system in terms of NPC ($ 7.86M), COE (0.154 $/kWh), operating cost (339,775 $/yr), and renewable energy fraction of 24.6%.

Session 12: Distributed Generation and Energy Storage Technology

Time: 16:15-18:30, Dec. 19, 2021, Beijing Time, GMT+8
Session Chair: Prof. Lasse Berntzen, University of South-Eastern Norway, Norway
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P56

16:15-16:30

The Aggregator as a Storage Provider
Authors: Lasse Berntzen, Qian Meng, Marius Rohde Johannessen, Boban Vesin, Thomas Brekke, Inessa Laur
Presenter: Lasse Berntzen, University of South-Eastern Norway, Norway

Abstract: The energy transition from fossil resources to integration of more renewables such as solar and wind has become the focus in the energy strategies of many countries. The time difference between solar energy production and power demand peak hours in the grid can be significant, bringing the role of electricity storage, especially battery systems, to center stage. Based on this fact with data from the solar energy output at Oslo and Nord Pool electricity prices, the revenue potential for storage is calculable. For the prosumers acting as both energy users and producers, storage is installed mainly for selfconsumption. In comparison, storage with aggregators may achieve profit out of the outrage of the market price fluctuation.

P87

16:30-16:45

Research on the development scale and economics of the distributed photovoltaic under the policy of developing photovoltaic throughout the county
Authors: Rui Chen, Hongcai Dai, Jianmin Zhang, Xiaoyu Wu, Zhenlan Dou, Chunyan Zhang, Fan Cheng
Presenter: Rui Chen, Energy Internet Institute State Grid Energy Research Institute, China

Abstract: The policy of developing the distributed photovoltaic (PV) throughout the county is proposed in China, which will make China's distributed PV face a new development situation. This paper studies the potential development scale and the economics of distributed photovoltaics in Chinese counties under the new situation. Firstly, the development status and development model of distributed PV in China are analyzed. Secondly, the potential scale and distribution characteristics of the distributed PV in China's counties are calculated and analyzed. Finally, the economic evaluation model is constructed to analyze the economics of the power supply. The results show that the average power supply cost of distributed PV can be reduced by 10.28% compared with the existing power supply mode of the power grid.

P194

16:45-17:00

Research on Optimal Configuration of Distributed Photovoltaic with Typical Day Scene Generation Technology
Authors: Ning Luo, Hua Gao, Yan Zhang, Yu Zhang
Presenter: Ning Luo, Power Grid Planning Research Center of Guizhou Power Grid Co., Ltd, China

Abstract: Distributed photovoltaics are connected to the distribution system in large numbers and their optimal allocation is a new hot topic for research. In this paper, we propose a distributed photovoltaics optimal configuration method based on typical daily scenarios. First, this paper preprocesses the original input distributed photovoltaics output history data and uses K-means clustering algorithm to generate distributed photovoltaics typical daily output scenarios in all year round. Then, this paper establishes a distributed photovoltaics optimal allocation model with the sum of various types of costs of distributed photovoltaics access as the objective, and solves the model using an improved genetic algorithm. Finally, this paper uses a typical day

scenario to simulate and validate the distribution system example of IEEE 33-bus. The analysis results display that the distributed photovoltaics optimal allocation model proposed in this paper can boost the economy of the distribution system and significantly decrease the system loss of the distribution system.

P64

17:00-17:15

Reactive Power Response Behaviour Modelling and Prediction Algorithm of Distributed Photovoltaic Generation

Authors: Di Ge, Zhifei Cai, Jitao Niu and Liang Yuan

Presenter: Di Ge, State Grid Henan Electric Power Company Xuchang Power Supply Company, China

Abstract: In this paper, the reactive power response behavior model of distributed photovoltaic generation participating in voltage control is established by the model driven method, and the neural network method based on trust-tech is used to predict the response behavior. The reactive power response behavior model is firstly built based on the physical model of distributed photovoltaic generation, where the reactive power response capacity and response cost are formulated. Then the neural network prediction method based on trust-tech is adopted to predict the active power output of the distributed photovoltaic generation, and hence the reactive power response behavior is predicted based on the predicted active power output and the proposed reactive power response behavior model. The effectiveness of the proposed method is verified by simulation examples.

P110

17:15-17:30

Application of Distributed Energy Storage in New Power System

Authors: Zhifeng WEI, Hongli SU, Zhongping XU, Haiyang LIU, Mengjie ZHAO

Presenter: Hongli SU, Beijing SGITG Accenture Information Technology Center CO., Ltd.,China

Abstract: The structure and operation mode of traditional power system have changed greatly in the new power system with new energy as the main body. Distributed energy storage is an important energy regulator in power system, has also ushered in new development opportunities. Based on the development status of energy storage technology, the characteristics of distributed energy storage technology and its application potential and value in clean and renewable energy are analyzed. It focuses on the application mode and typical scenarios of distributed energy storage. Clarify the application and development direction of distributed energy storage in the construction of new power system.

P190

17:30-17:45

Research on the Adjustment of TOU Price Considering Large-Scale Renewable Energy Grid Integration

Authors: Wenjuan Niu, Kaihui Nan, Yi Ge, Delv Zhu, Meng Ni, and Beibei Wang

Presenter: Meng Ni, Southeast University, China

Abstract: At present, China's power supply structure and energy consumption pattern have undergone new challenges, and a new power system with renewable energy as the main supply is being constructed. However, the time block division in some regions has not been able to meet the developing requirements of the new condition. In addition, the current peak-valley difference still has room to expand. Small price difference may lead to the weakening of load regulation. Therefore, by constructing various electricity pricing mechanisms and analyzing users' satisfaction degree and load transfer level, this paper optimizes the current electricity price system, encouraging users to use electricity reasonably and promoting the development of renewable energy.

P141

17:45-18:00

Optimal Sizing of Hybrid Wind-Storage System for Load Shifting

Authors: Zhonghao Qian, Sheng Jiang, Liudong Zhang, Lei Mao, Liang Zhou, Song Yuan and Jun Zhang
Presenter: Sheng Jiang, Shanghai Jiao Tong University, China

Abstract: With the increasing penetration of renewable energy in power system, energy storage systems (ESSs) are expected to undertake the responsibility for load shifting, so as to reduce the burden of traditional generators. However, the improper size of an ESS will lead to an undesired cost even cause instability. In order to maximize total profits of hybrid wind-storage systems, an economic sizing method for an ESS is proposed in this paper, considering the cycle life loss of an ESS To address above, the particle swarm optimization algorithm is employed to jointly optimize the capacity of an ESS and the coefficient of load shifting. With the help of the proposed method, both the operation cost and greenhouse gas emissions of the hybrid wind-storage system are reduced. The simulation results demonstrate the effectiveness of proposed method.

P180

18:00-18:15

Scheduling Strategy of Energy Storage Peak-shaving and Valley-filling Considering the Improvement Target of Peak-valley Difference

Authors: Yudong Tan, Ming Wen, Jing Liao, Canlin Wang, Ying Liu, Ting Ouyang
Presenter: Ting Ouyang, Changsha University of Science & Technology, China

Abstract: In order to make the energy storage system achieve the expected peak-shaving and valley-filling effect, an energy-storage peak-shaving scheduling strategy considering the improvement goal of peak-valley difference is proposed. First, according to the load curve in the dispatch day, the baseline of peak-shaving and valley-filling during peak-shaving and valley filling is calculated under the constraint conditions of peak-valley difference improvement target value, grid load, battery power, battery capacity, etc. Then formulate the corresponding scheduling strategy execution process, and construct the scheduling strategy evaluation index. Finally, taking the actual load data of a certain area as an example, the advantages and disadvantages of this strategy and the constant power control strategy are compared through simulation, and it is verified that this strategy has a better effect of peak shaving and valley filling.

P146

18:15-18:30

Research on transaction and control technology for new power system presenting centralized-distributed pattern

Authors: Cheng Chi, Hai Zhao, Jinsong Liu, Bin Li, Yue Han, Wei Fan
Presenter: Cheng Chi, 1.Northeastern University; 2.State Grid Liaoning Electric Power Research Institute, China

Abstract: China is vigorously building the power system with new energy as the main body, a lot of distributed new energy sources will connected to the power grid, the power system gradually presents the form of centralized distributed coupling and coordination. The traditional centralized management mode is difficult to adapt to the future power system, so it is necessary to analyze the power trading and dispatching modes suitable for the new power system. This paper analyzes the framework of coupled collaborative power system in centralized distributed form, and discusses the establishment of new power trading methods and control modes by using block chain technology and distributed power grid management mode.

Session 13: HVDC Transmission and Relay Protection

Time: 9:30-12:00, Dec. 20, 2021, Beijing Time, GMT+8
Session Chair: Prof. Sidun Fang, Chongqing University, China
Zoom Link: https://zoom.us/j/96203075575 Password: 121820

P39

9:30-9:45

Research on Active Voltage Regulator for HVDC Commutation Failure Inhibition
Authors: Yongzheng Zhang, Zhiyong Yu, Ding Zhou, Zhanfeng Deng, Guoliang Zhao
Presenter: Yongzheng Zhang, Global Energy Interconnection Research Institute Co.Ltd., China

Abstract: This paper presents the research of an active voltage regulator (AVR) aimed to inhibit commutation failure in HVDC systems. The developed voltage regulator which consists of several cascaded AC/AC converters is able to accomplish voltage regulation under both normal and fault conditions. When a fault occurs at the AC system and commutation failure is detected, the corresponding AVR is capable of responding to the sudden disturbance by compensating a certain voltage to the AC system so that further commutation failure could be inhibited. The performance of the proposed AVR is assessed through simulation test using PSCAD. The obtained results indicate that the proposed AVR can effectively inhibit the commutation failures during different types of faults.

P70

9:45-10:00

Research and Application of AC filter fastswitching off Strategy in Matiari-Lahore HVDC Project
Authors: Sheng WANG, Peng YANG, Tengliang LI, Weixin SUN, Qingfan WU, and Yulong LI
Presenter: Sheng WANG, XJ Group, China

Abstract: Due to AC filters slow speed excision, short-time reactive power surplus will lead to serious AC system overvoltage after HVDC bipolar blocking according to the present reactive power control strategy. The overvoltage may cause equipment damage and deteriorate AC system stability. The paper proposes a AC filter fastswitching off strategy after HVDC bipolar blocking, and the feasibility of the strategy is verified by the RTDS simulation of Matiari-Lahore ±660kV/4GWHVDC project in Pakistan, which is under commissioning now and will be in operation in 2021. The simulation shows that the risk of excessive reactive power and AC overvoltage can be effectively minimized, and the strategy was implemented in the project.

P173

10:00-10:15

Optimization Scheme for the SSC Discrimination Logic of Xinsong-Dongfang HVDC under Small Islanded Operation Mode
Authors: Yukun Zhu, Chengxiang Li, Yihua Zhu, Dongxu Chang, Shengnan Li and Yong Chen
Presenter: Yukun Zhu, Electric Power Research Institute, China Southern Power Grid, China

Abstract: The sending end of HVDC in islanded operation mode is a weak AC system, the security and stability control (SSC) system is very important for the operation of the islanded system. In this paper, the SSC strategy of Xinsong-Dongfang HVDC under islanded mode is deeply analyzed, and the defects and risks of the SSC discrimination logic for the small islanded operation mode is exposed during the RTDS simulation tests, as a result, some of the generators cannot be cut off. In addition, Then the research of the action sequence of SSC reveals the improper time coordination between the small islanded mode signal and the cut-off command. Based on the above work, an optimized scheme to discriminate the small islanded operation mode is proposed, and the correctness and effectiveness are verified through the same RTDS

tests. This new method has great significance in the SSC design and implementation in HVDC transmission project with similar techniques.

P29

10:15-10:30

Design of Coordination Controller in AC-DC Hybrid System
Authors: Panpan Deng
Presenter: Panpan Deng, Leshan Vocational and Technical College, China

Abstract: For the AC/DC interconnection system with generator and HVDC transmission including excitation control, this paper designs the coordination controller of generator excitation and HVDC. Firstly, the mathematical model of the whole system is established, then the nonlinear control theory is used to linearize the system accurately, and the coordinated control strategy is obtained by combining the optimal coordinated control theory. Finally, simulation results with EMTDC program show that the above coordination controller can effectively improve the stability of the whole system.

P147

10:30-10:45

Controlled Islanding Section Search Method Considering Connection Constraints of Back-to-Back VSC-HVDC Composite Devices
Authors: Jiajun Liu and Chaolong Guo
Presenter: Chaolong Guo, Xi'an University of Technology, China

Abstract: In order to solve the problem of voltage and frequency violation caused by the power imbalance between the independent subsystems of the traditional AC power grid, the back-to-back VSC-HVDC composite device is connected to the AC power grid, and a power system controlled islanding splitting based on an improved spectral clustering algorithm is proposed. Section search method. Through the improved spectral clustering algorithm, the problem of grid splitting partitioning is mapped to the optimal segmentation problem of the graph, and the objective function is to minimize the comprehensive influence of the active and reactive power flow impacts at the section and the electrical distance between nodes on the grid splitting. Solve the power grid partition section; through the back-to-back VSC-HVDC composite device connection constraints and control commands, the power control exchange between islands after the grid is decommissioned is realized, and the power flow balance of the system is maintained. The simulation results prove the correctness and effectiveness of the proposed method of active segmentation cross-section search.

P113

10:45-11:00

Research on the coordination control strategy of variable speed pumping storage unit and multi-terminal flexible and straight system
Authors: Weidong Chen, Jianyuan Xu, Xiaoheng Zhang, Xinwei Li, Shichuan Feng and Haoran Chen
Presenter: Weidong Chen, Shenyang University of Technology, China

Abstract: To satisfy the absorbing capacity of a high proportion of new energy in future power systems, a flexible HVDC transmission system is the first choice of new energy base resource delivery, and a variable speed pumping storage unit is one of the best solutions to ensure the stability of new energy delivery power system. Based on Zhang Bei engineering structures containing flexible HVDC system, and based on the variable speed pump storage unit set up simulation system with soft the differences between the direct power control system characteristic and variable speed pump storage unit with soft straight system coordinated control strategy, the matching of variable speed pump storage unit and soft straight system control performance, avoid to produce control conflict, To improve the system quickly absorb large-scale new energy power generation capacity. This paper studies the fluctuation characteristics of large-scale new energy and the operation characteristics of pumped storage power stations on a long time scale, and puts forward the optimal operation mode of pumping storage power station and PlUS-direct combined system in a long time scale according to their

coordination.

P13

11:00-11:15

Research on Influence of AC Neutral Grounding Impedance on Common Mode Current of MMC Flexible DC System

Authors: Xu Xinsen, Wang Jing, Zhao Yuming, Qin Wenkang and Xu Xidong
Presenter: Xu Xinsen, Zhejiang University, China

Abstract: Among all flexible DC system grounding methods, converter's AC side grounding is an important one. Modular multilevel converter (MMC) with the third harmonic injection modulation strategy can improve the utilization of DC voltage. The third harmonic current will be generated when MMC with neutral point grounded on AC side adopts the third harmonic injection modulation, because of the third harmonic potential. This paper describes the characteristics of the common mode voltage produced by the AC side grounded modular multilevel converter under the third harmonic modulation. Taking the flexible DC system with MMC at both ends as an example, the common mode equivalent network of the system with AC side neutral grounded through impedance is established. This paper analyzes the influence of neutral grounding impedance of connecting transformer and voltage angle difference of AC system on common mode voltage and current of DC system, considers the power loss of the grounding impedance and proposes a common mode current suppression method based on series grounding of resistance and reactance, so as to realize the third harmonic modulation of MMC flexible DC system with AC side grounding. Finally, it is verified on PSCAD simulation platform.

P149

11:15-11:30

Simulation and measurement analysis of transient ground potential rise in GIS of 110kV Substation

Authors: Qingping Zhang, Zhenhua Yan, Xiuguang Li, Shuang Zhang, Bo Gao and Xuefeng Li
Presenter: Qingping Zhang, Electric Power Research Institute State Grid Ningxia Electric Power Co.,Ltd., China

Abstract: VFTO will be generated during the operation of GIS disconnectors, circuit breakers and other switchgear. This fast transient process will often cause the circulating current of GIS shell and the transient potential rise of GIS shell to ground. In order to study the potential rise mechanism, the transient ground potential rise caused by disconnector operation in a 110kV GIS Substation is simulated and measured on site. By comparing the measured data with the simulation calculation results, the TGPR distribution characteristics of the station are analyzed, and it is found that the two results are consistent. The analysis results will provide a certain reference for formulating the protection and suppression measures of TGPR.

P100

11:30-11:45

Research on Dielectric Recovery Process of Circuit Breaker under Multiple Lightning Impulse

Authors: Yunlong Lv, Fan Ding, Yutang Ma, Dong Lei and Jixing Sun
Presenter: Yunlong Lv, Beijing Jiaotong University, China

Abstract: In view of the frequent occurrence, destructive and multiplicity of lightning accidents in transmission lines, the arc characteristics of circuit breakers under multiple lightning conditions are studied. The model of dielectric recovery process of circuit breaker under multiple lightning impulse is established by using the multi physical field simulation software. The transient process of arc development under multiple lightning impulse and the distribution characteristics of temperature field, air flow field and electric field in arc extinguishing chamber are obtained. The results show that the process of arc temperature is consistent with the development of multiple lightning impulse current, and the maximum temperature increases with the increase of lightning current amplitude; The distribution and time-varying characteristics of electric field in

arc extinguishing chamber are analyzed under different time nodes. The maximum value of electric field is mainly concentrated in the dynamic and static contact; With the increase of lightning current, the air velocity increases rapidly. The arc shape is gradually developed from the original column to the arc with bending shape along the direction of the increase of the gas flow velocity. The research provides the basis for the high voltage insulation coordination and the optimal design of the circuit breaker.

P04

11:45-12:00

Geotechnical stability analysis of a mast site under geological hazard
Authors: BU Xianghang, CAO Yongxing, WANG Bo, GUO Yujun
Presenter: WANG Bo, Southwest Jiaotong University, China

Abstract: As the support carrier of transmission lines, transmission towers are of great importance to the safe operation of the power grid. Geological changes and disasters often lead to the displacement of transmission towers, which eventually cause them to tilt or even collapse and fail, seriously threatening grid security. In order to accurately evaluate the stability of the mast and ensure the safe operation of the power grid, this paper investigates the historical occurrence of disasters at the site and the distribution of hazardous areas in China, and simulates the influence of geological changes on the transmission mast to obtain the weight of the influence of geological disasters on the stability of the transmission mast, which provides a reliable standard for evaluating the stability of the mast.

Session 14: Power Market and Power Enterprise Management

Time: 9:30-12:00, Dec. 20, 2021, Beijing Time, GMT+8
Session Chair: Assoc. Prof. Xu Wang, Shanghai Jiao Tong University, China
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P179

9:30-9:45

Research on key technologies and business models of low-carbon transformation of power industry under the "double carbon" trend
Authors: Ziwei HONG, Hongli SU, Haiyang LIU, Mengjie ZHAO
Presenter: Ziwei HONG, Beijing Yuancheng Technology Co.,Ltd. Beijing, China

Abstract: The electric power industry is the primary area to achieve the "double carbon" goal, and its low-carbon development plays a role in promoting China to achieve the "double carbon" goal. The proposal of the goal of "double carbon" has a deep impact on many aspects of the power industry, and the clean transformation of the power industry has become the general trend. This paper starts from China's actual national conditions and carbon emission reduction targets. Starting from China's actual national conditions and carbon emission reduction targets, based on the current situation of China's energy structure and the current domestic "double carbon" situation, we focus on the theme of high-quality energy development in China's power industry under the goal of "double carbon", and analyze the challenges and opportunities in the process of development and implementation based on the current situation of the power industry. This paper provides low-carbon transformation ideas for building a new power system with new energy as the theme and promoting the realization of the goal of "carbon neutrality".

P12

9:45-10:00

Stochastic Optimization of Dispatchable Load Response and Punishment Price with Response Uncertainty
Authors: Tao Zhou, Hanhan Qian, Wei Zhang, Tianyang Fang, and Shenghu Li
Presenter: Tianyang Fang, Hefei University of Technology, China

Abstract: Dispatchable load (DL) participating in demand response (DR) will promote renewable energy consumption. But with limited regulation capability, the response of the DL is uncertain, which is undesirable to the market participators. A punishment mechanism for response deviation may be set. But a loose punishment is not effective, but severe punishment will reduce the enthusiasm of DL supplier. This paper takes the response deviation as random contributing factor. A stochastic optimization model of the DL clearing price and punishment price is proposed based on the relationship between response price and amount, punishment price and response deviation. With the expectation model, it is transformed to deterministic optimization model. Numerical results are provided to validate the proposed models.

P128

10:00-10:15

Research and application of electricity carbon emission on user side of power enterprises
Authors: Fei Yin, Cong Ji, Quan Sun, Wenjun Qi, Zhiying Zhong, Hongli Su
Presenter: Fei Yin, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: In order to deal with the global climate problems caused by the greenhouse effect, countries have formulated carbon emission reduction strategies. China has put forward the goals of "carbon peak" and "carbon neutrality". By optimizing the energy structure and taking the reform of the power industry as an opportunity, we strive to achieve the goal of "double carbon". Taking the power enterprise users as the research object, this paper puts forward the concepts and algorithms of kWh electric carbon emission and electric carbon neutrality index, and carries out the analysis and application of typical scenarios of electric carbon emission on the user side, so as to

provide a reference basis for evaluating the process and effectiveness of carbon neutrality and fulfilling the emission reduction commitment.

P177

10:15-10:30

Research and Exploration on the construction of new power system in power industry
Authors: Hongli SU, Ziwei HONG, Cong JI, Mengjie ZHAO
Presenter: Ziwei HONG, Beijing Yuancheng Technology Co.,Ltd. Beijing, China

Abstract: Building a new power system with new energy as the main body is an important content of implementing the goal of "emission peak and carbon neutrality" and promoting the green and low carbon transformation of energy, which is the development mission of the power industry in the new era, the clean transformation of electric power industry has become the general trend. Starting from China's actual national conditions and carbon emission reduction targets, combining with the current application situation of clean energy in China, this paper focuses on the clean transformation of new power system, from the source of governance, market expansion, three aspects of technological innovation put forward the key path of new power system construction.

P41

10:30-10:45

Bilateral Transaction of Changing Subjects in Reformed Electricity Spot Market
Authors: Piaohong Kong, Liqiang Yang, Zhenyu Hu, Xueshan Lin, and Beibei Wang
Presenter: Xueshan Lin, Southeast University, China

Abstract: With the promotion of electricity market reform, the renewable energy resource and elastic demand gradually turned to the mean subject of electricity market transaction. Due to the inaccurately forecasts of the renewable energy output value, the renewable energy consumption in electricity spot market is insufficient. Therefore, the power waste of renewable energy increases year by year with the increase of installed capacity of the renewable energy resources. Through the bilateral transaction model based on the Bayesian game, the Bayes-Nash equilibrium point of the quoted price and quantity of both sides can be calculated. Among them, the quoted price calculation considers the game process of demand-side and supply-side. The quoted quantity calculation considers the supply-side game and the demand-side game, respectively. Also, the actual operation of the electricity spot market is considered. The simulation results illustrate the bilateral transaction model can well applicated in the reformed electricity spot market.

P93

10:45-11:00

Optimization decision model of electricity market under renewable portfolio standard
Authors: Xiaofan Lin, Wanqing Chen, Han Chen, Jinchun Chen, Simin Chen, Guannan Chen
Presenter: Xiaofan Lin, Power Economic Research Institute of State Grid Fujian Electric Power Company, China

Abstract: Renewable portfolio standard (RPS) is a policy to promote the development of renewable energy in many states and regions such as the United States and Australia. Renewable energy company can not only sell electricity in the electricity market, but also obtain renewable energy certificate (REC) to sell to power users to obtain additional profit. Based on the above framework, a bi-level optimization model of multi-body decision including day-ahead market, real-time market and REC market under the RPS has been established, and it has been transformed through Karush-Kuhn-Tucker conditions, strong duality theorem, binary expansion method, etc. It is converted to a mixed-integer linear programming to find the market equilibrium. The case study analysis explores the impact of renewable energy output, market power, and REC market on the joint market equilibrium of the electricity market and REC market. The results show that renewable energy output shows a certain negative correlation with local marginal price. The introduction of the REC market is conducive to weakening the market power and strategic bidding behavior of renewable energy

company.

P178

11:00-11:15

Research on Business Model Transformation of Power Enterprises Under the Trend of "Double Carbon"

Authors: Zhifeng WEI, Hongli SU, Ziwei HONG, Mengjie ZHAO

Presenter: Ziwei HONG, Beijing Yuancheng Technology Co.,Ltd. Beijing, China

Abstract: Emission peak and carbon neutrality are the goals proposed by major economies around the world in the medium and long term in order to cope with global warming. Countries have issued corresponding systems and regulations. Energy and electricity are the main force to achieve the "double carbon" goal. This paper explores the electric power business model from the aspects of infrastructure upgrading, electric energy replacement, comprehensive energy services, and promoting the carbon neutralization market mechanism, etc., seizing the development opportunity of the country to build carbon neutralization.

P127

11:15-11:30

Research and Application of Carbon Emission From Electricity Consumption of Typical Users

Authors: Quan Sun, Cong Ji, Fei Yin, Wenjun Qi, Zhiying Zhong and Hongli Su

Presenter: Quan Sun, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: In 2020, China put forward the goal of 2060 carbon neutrality in the general discussion of the United Nations General Assembly. In order to accelerate the realization of the ultimate goal of carbon peak and carbon neutrality, as the main force of China's carbon emission, power enterprises must seek the development path of low-carbon transformation. Based on the real-time data of water, electricity, gas, heat, coal and oil accessed by the platform and the data of users' photovoltaic energy and clean energy, this paper establishes an electric carbon neutrality index algorithm model, carries out carbon emission evaluation, and assists in the evaluation and diagnosis of carbon reduction methods in production processes, Promote typical cases of low-carbon energy consumption, realize customization and carry out comprehensive energy efficiency services.

P150

11:30-11:45

Electric Vehicle Charging Demand Forecasting Based on City Grid Attribute Classification

Authors: Kaiyu Zhang, Yingjie Tian, Shanshan Shi, Yun Su, Licheng Xu, Meixia Zhang

Presenter: Licheng Xu, Shanghai University of Electric Power, China

Abstract: In order to improve the accuracy of user travel behavior and traffic road condition description in EV charging demand prediction research, a method of EV charging demand prediction based on urban grid attribute division is proposed. Firstly, the study area is determined based on the distribution of net car trips, and then the study area is precisely divided into functional areas based on the urban point-of-interest data crawled by Python, and then the spatio-temporal characteristics of residents' trips are obtained by mining; finally, considering the charging characteristics of electric vehicles, a complete charging demand prediction model is established, and the travel behavior of electric vehicles under different spatio-temporal distributions in the Second Ring Road area of Chengdu is simulated by Monte Carlo sampling method and The simulation results show that the proposed charging demand prediction method can effectively predict the charging demand in different areas and different scenarios.

P111

11:45-12:00

Exploration on the Development and Transformation of Power Industry under the Trend of Double Carbon

Authors: Hongli SU, Zhifeng WEI, Cong JI, Mengjie ZHAO

Presenter: Hongli SU, Beijing SGITG Accenture Information Technology Center CO., Ltd.,China

Abstract: The power industry is the primary area to achieve the "double carbon" goal, its low-carbon development plays a role in promoting China's realization of the "double carbon" goal. Starting from China's actual national conditions and carbon emission reduction targets, combined with the current situation of China's energy structure and the current domestic "double carbon" situation. The challenges and opportunities for high-quality energy development of China's power industry under the "double carbon" goal are obtained. On this basis, four dominant ways for China's high-quality energy development under the goal of "carbon neutrality" are put forward. That is, energy conservation and efficiency improvement, optimization of energy structure, technological innovation and breakthrough, and building a new power system with new energy as the main body.

Session 15: Power Communication and Information Management

Time: 13:30-16:00, Dec. 20, 2021, Beijing Time, GMT+8
Session Chair:
Zoom Link: https://zoom.us/j/96203075575 Password：121820

P130

13:30-13:45

Research on Deployment Technology of Oracle Database 4-Node Rac in Power Consumption Information Acquisition System
Authors: Wenjun Qi, Shuai Shuai, Hui Chen, Wenjie Li, Zhiying Zhong and Fei Zheng
Presenter: Wenjun Qi, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: With the increasing load of the Power Consumption Information Collection System, the high CPU rate of the two-nodes Oracle RAC system lasts for a long time, and the use of 100% CPU appears often, this appearance seriously infected the stability of our system. Under the condition of the former resources cannot be increased, we consider to add two cluster nodes to share some part of business load, the load will be transferred to the new two nodes, and then the CPU rate of the database servers will be reduced. At last our Power Consumption Information Collection System will be stable to provide services. In this paper, the way of four-nodes Oracle RAC is studied and explored for the Power Consumption Information Collection System.

P88

13:45-14:00

Research on Sensing and Monitoring Technology of Complicated Cable Tunnel Based on Wireless Ad-Hoc Network
Authors: Yinbai Xu, Chenbin Wu, Ling Li, Qi Yuan, Jun Xia, Yunzhi Pei, Kan Chen, Ling Wang
Presenter: Yinbai Xu, State Grid Shanghai Cable Company, Shanghai, China

Abstract: In order to solve the wireless data transmission problems of the monitoring devices and equipment in the complex cable tunnel, this paper analyzes the wireless communication difficulties of the cable tunnels' curve structure by studying the electromagnetic wave transmission characteristics in the complex environment of the cable tunnel, combined with the actual test on the spot. Adopting Mist mesh low-power wireless ad-hoc network sensing technology to solve the wireless sensing problems in complex environments such as cable tunnel corners and multi-floor shafts through adaptive networking and other technologies. The reliability of wireless ad-hoc network is verified by field experiments, and therefore provides a technical basis for subsequent research work such as unmanned inspection, online monitoring, fault location, and emergency communication of the cable tunnel. Besides, a comprehensive wireless monitoring system for cable tunnels was developed.

P126

14:00-14:15

Design and implementation of gray publishing system under distributed application microservice
Authors: Hui CHEN, Wenjun QI, Wenjie LI, Shuai SHUAI, Fei ZHENG, and Zhongjie YU
Presenter: Hui CHEN, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: The release of the information system version poses a certain risk to the normal operation of the system. Based on the information system micro service architecture, this paper studies the entrusted management of the information system according to the EDAs gray level table under different gray levels, and provides all-round solutions in combination with the different needs of system development, configuration, monitoring, operation and maintenance, so as to effectively improve the core computing capability of the platform under the micro service architecture and realize the online release and loss free return of the system, Reduce system release risk and improve system service quality.

P2001

14:15-14:30

Power Monitoring System Based on Industrial Internet of Things
Authors: Hongyu Sun, Dong Han, Geng Chen, Song Wang, Ao Wang, Die Zhang
Presenter: Dong Han, Shandong University of Science and Technology, China

Abstract: The paper proposed a power monitoring system based on RN7302 chip. The system can support a variety of communication modes and be widely used in the industrial IoT (Internet of things). In order to improve the robustness of the system to meet requirements of different industrial IoT, edge gateway and node red are combined in the system. Moreover, the physical world and the digital world are connected through network connection, protocol conversion and other functions. The system realizes the functions of lightweight connection management, real-time data analysis and application management. Finally, combining Lora communication technology, edge computing and industrial Internet of things technology, the whole system is designed. The experimental results show that the proposed power monitoring system is feasible and potential.

P172

14:30-14:45

Analysis on Influencing Factors of Capacity Optimal Allocation in Energy Network Planning
Authors: Guanglong Xie, Hang Xu, Chen Zhang, Xun Du, Jiafu Wu
Presenter: Xun Du, State Grid Energy Research Institute, China

Abstract: With the development of the times, a single form of energy supply has been difficult to meet the current load demand. The concept of energy Internet came into being. It forms the internet through various coupling equipment, such as electricity, gas and heat, so as to realize the efficient utilization of energy. In order to maximize benefits, it is often necessary to optimize the capacity allocation and reasonably allocate heterogeneous energy input. Considering the equipment tolerance, it is necessary to set the equipment operation boundary. At present, most studies focus on analyzing the power flow distribution under the determined boundary conditions.

P129

14:45-15:00

Research and Verification of Real-time Query Technology
Authors: Jike Ma, Fei Yin, Yefei Li, Quan Sun and Shuai Shuai
Presenter: Jike Ma, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: At present, with the rapid development of digital technology, power enterprises need to improve business operation efficiency and management level with the help of digital means. Based on the urgent need for real-time query of electricity business, electricity recovery statistics, electricity bill list, power sales briefing and other businesses, this paper analyzes and designs the technical architecture and data flow diagram of real-time query library, carries out component verification from two aspects of core competence and typical scenarios, and analyzes the characteristics of different technologies of ADB and Hologres, The optimization suggestions and directions are given.

P191

15:00-15:15

Scenario Analysis for Carbon Emission in Energy Internet
Authors: Yin Zhang, Hui Peng, Ye Liao, Xuechao Wu and Jingui Chen
Presenter: Ye Liao, State Grid Xiamen Power Supply Company, China

Abstract: This paper analyzed the calculating methods of carbon emission in typical scenes of Energy Internet, which decided the formation of carbon emission in these scenes and carbon emission changes after using related techniques. This paper made mathematical analysis on every scene's carbon emission, and ranked the whole performance of every scene in Energy Internet. Through detailed analysis and simulation result, it can conclude that the important sectors of curbing carbon emission in Energy Internet mainly lie in massive scale using of renewable energy, utilizing CCHP to replace diesel generator, and using intelligent energy managing and optimization technologies which can improve the energy using efficiency apparently

and reduce carbon emission largely. Based on above observations, we can further wisely decide the carbon emission policies and realize carbon peaking and carbon neutralization in Energy Internet as quickly as possible.

P169

15:15-15:30

Application of Electric Power Mobile Work Attendance Based on Electronic Fence
Authors: Zuo Chen, Fei Yin, Zhijie Liu, Cong Ji and Fei Zheng
Presenter: Zuo Chen, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: With the rapid development of economic globalization, the business scope of enterprises is no longer limited by region and expands in a broader direction. Many enterprises develop their business to all parts of China and even abroad. Therefore, enterprises need a large number of staff to go out at any time or complete work tasks abroad for a long time. In order to further strengthen personnel management and ensure work quality and efficiency, this paper studies the attendance management method of enterprise employees going out. With the help of high-precision Beidou satellite positioning technology and electronic map, an electronic fence for employee mobile attendance is designed to realize the fine and standardized management of employee attendance.

P21

15:30-15:45

A Critical Evaluation of Cloud Computing Techniques for TSO and DSO Information and Data Exchange
Authors: Mubashar Amjad, Gareth Taylor, Moazhen Li, and Zhengwen Huang
Presenter: Mubashar Amjad, Brunel University, London

Abstract: Enhanced coordination between Transmission System Operators (TSOs) and Distribution System Operators (DSOs) is becoming more essential with each passing year. Consequently, data exchanged between TSOs and DSOs is of key importance with regard to enabling the operational capabilities of the power system as a whole. In this paper cloud computing techniques are investigated with regard to information and data exchange between TSOs, DSOs, and other actors or participants. Cloud computing is becoming extremely popular for flexibly accessing computational resources. Information and data exchange via cloud computing is reliant on networked services that can be reliably and securely shared over the internet. Information and data exchange platforms enable relevant electrical power system actors to access different services according to their needs using a web portal. Some of the major cloud providers are Amazon AWS, Microsoft Azure, and Cloudera. This paper critically evaluates and compares different data exchange platforms that support information and data exchange between TSOs, DSOs, and other actors or participants. A range of relevant Use Cases have been considered and their results have been analyzed and evaluated based on their execution time.

P166

15:45-16:00

Research on Power Marketing Data Archiving and Integrity Protection Strategy
Authors: Wenjun Qi, Wenjie Li, Yan Pan, Hui Chen and Chun Lv
Presenter: Wenjun Qi, Jiangsu Frontier Electric Power Technology Co., Ltd, China

Abstract: In recent years, the data of electricity marketing system in billing, accounting, business expansion, metering and other business has increased rapidly. In order to ensure the stable performance of the core business of the marketing system and maintain the stable growth of data, we should plan the production data archiving and protection plan as early as possible to ensure the stable operation of the system. This paper defines the principles of historical archiving and backup of marketing information systems, designs technical implementation methods and routes, and provides guidance for the development and implementation of power marketing data archiving and Integrity Protection.

Session 16: Electrical Equipment Design and Control

Time: 13:30-16:00, Dec. 20, 2021, Beijing Time, GMT+8
Session Chair: Dr. Yiyan Sang, Shanghai University of Electric Power, Chinas
Zoom Link: https://zoom.us/j/91686021996?pwd=NDBmQ0pwQUlSY05BMzVCRlNFVjY3Zz09
Password：121820

P119 13:30-13:45

Control Parameter Design of Three-phase Grid Connected Inverter Based on LCL Filter
Authors: Jianying Zhong, Yitao Wei, Baoxin Yang, Tiehan Cheng, Jianyuan Xu and Zheng Yan
Presenter: Zheng Yan, Shenyang University of Technology, China

Abstract: This paper mainly studies the mathematical model and control strategy of three-phase grid connected inverter, established its mathematical models in abc three-phase static coordinate system, αβ two-phase static coordinate system and dq two-phase synchronous rotating coordinate system. Then analyzed its working principle and control strategy in detail, so as to lay a theoretical foundation for the research of control parameter design of three-phase grid connected inverter based on SPWM Control.

P189 13:45-14:00

A One-Dimensional Physics-based Compact Model of Reverse Blocking IGCT Devices
Authors: Xuan Zhou, Chijie Zhuang, Rong Zeng, Chunpin Ren, Chaoqun Xu, Zongze Wang
Presenter: Zongze Wang, Tsinghua University, China

Abstract: Integrated gate commutated thyristors (IGCTs) have the potential to be applied in power electronic systems of DC grid. The reverse blocking IGCT (RB-IGCT) is a full-controlled device with the ability to withstand reverse voltages, which can be applied into DC breakers and converters. A one-dimensional physics-based compact model of RB-IGCT devices has been proposed in this paper. The compact model takes into account the moving boundaries of carrier storage region in N base region, with the variable widths of J1 depletion layer and J2 depletion layer. The model can simulate both external electrical waveforms and internal physical information such as carrier density distribution of RB-IGCT devices under different conditions, including triggered turn-on/turn-off processes and reverse blocking process. The RB-IGCT compact model is expected to be applied in the simulation of core equipment in DC grid and provide reference for device selection and circuit design in the near future.

P60 14:00-14:15

Parameters Design of Modular Multilevel Converter Based on Safe Operation Area of Power Device
Authors: Rui Xie, Bin Lin, Xiaohe Wang, Qing Chen
Presenter: Rui Xie, PowerChina Huadong Engineering CO., LTD., China

Abstract: A methodology for parameters design in modular multilevel converter based on safe operation area is proposed in this paper. The three-dimensional IGBT/diode electrical boundary and thermal boundary are established respectively and the safe operation area is the intersection of three boundaries. The key parameters are calculated with the safe operation area

P36 14:15-14:30

A Hybrid Control Scheme for the Dual-Active-Bridge dc-dc Converter with Fast Dynamic Response and Measurement Noise Suppression
Authors: Ming Zhong, Qilun Ao, Wei Zhang, Yuan Fan and Weiqi Meng
Presenter: Weiqi Meng, Tianjin University, China

Abstract: For dual-active-bridge (DAB) dc-dc converter, the disturbances of the output

voltage caused by the measurement noises are inevitable in the model-based control (MBC) schemes. Compared with the MBC strategy, the single-voltage-loop control (SVLC) method has the ability to suppress the measurement noise and provide more stable output voltage. However, the SVLC method always results in slow dynamic response. To achieve excellent performance under both dynamic and steady state conditions, this paper proposes a hybrid control scheme to combine the advantages of the MBC strategy and the SVLC method. When the load disturbance happens, the MBC scheme is selected for maintaining the output voltage during the transits. Once the required output voltage is obtained, the dominant control scheme is switched to the SVLC method. Taking the direct-power-control (DPC) scheme as an example, some experimental results are showed to verify the effectiveness of the proposed hybrid control strategy.

P132

14:30-14:45

Short-Time Scale Mode Transition Control of the Four-Switch Buck-Boost Converter
Authors: Hui Xu, Fei Wang, and Hui Guo
Presenter: Hui Xu, Shanghai University, China

Abstract: Four-switch Buck-Boost converters are widely used in applications with a large range of input and output voltages. The typical challenge of these converters is the mode transition control, which may result in the instability of output voltages, and could even damage the system. To solve this problem, existing research relies on various multimode control strategies to deal with smooth mode transitions in a relatively long-time scale. However, for applications such as DC microgrid that require faster mode transitions, an improved multimode control strategy with a duty cycle compensation method is proposed. A short-time scale mode transition is achieved, and the output voltage is maintained stable as well. Specifically, the basic principle, small-signal analysis, and the controller design are presented. The effectiveness and correctness of the proposed control are verified by simulations and experiments.

P118

14:45-15:00

Research on DAB triple phase shift control strategy based on current stress and soft switch dual objective optimization
Authors: Qiwu Zeng, Yitao Wei, Baoxin Yang, Jianyuan Xu and Dong Zhao
Presenter: Dong Zhao, Shenyang University of Technology, China

Abstract: Among the phase shifting control strategies of DAB converters, TPS control has the most control degrees of freedom and the largest optimization margin, which has been widely studied in recent years. Aiming at TPS control, this paper analyzes the basic characteristics of DAB converter, such as operation mode and soft switch, and proposes a dual-objective optimization control strategy that considers both soft switch condition and current stress, in order to reduce switching loss and on-state loss at the same time, and further improve the overall efficiency of the converter. The correctness of the strategy is verified by RT-LAB simulation.

P96

15:00-15:15

Nine-Level Active Neutral Point Clamped Converter with Cascading H-bridges Fed by Flying Capacitors
Authors: Alexander Suzdalenko, Huynh Van Khang, Janis Zakis, Victoria Sribniya
Presenter: Alexander Suzdalenko, Riga Technical University, Latvia

Abstract: A novel active neutral point clamped bidirectional multilevel inverter is proposed, consisting of flying capacitors with H-bridge interconnection circuit that allows for commutating any combination of flying capacitors and their polarity in the current path. The flying capacitor voltages are scaled by 1/2n factor to maximize the number of output voltage levels. Each intermediate output voltage pole has multiple possible combinations, where each flying capacitor can be charged or discharged, thus ensuring the simple capacitor voltage balancing capability within the same voltage pole. The simulation analysis demonstrated good performance and feasibility of the

proposed topology for high power converters.

P35

15:15-15:30

An Admittance Matrix Model of Thyristor-based Rectifier for Harmonic Analysis
Authors: Ming Zhong, Qilun Ao, Wei Zhang, Yuan Fan and Weiqi Meng
Presenter: Weiqi Meng, Tianjin University, China

Abstract: The analysis of nonlinear loads can help improve the filter design and guide the power-converters-based harmonic compensation. However, the analysis requires accurate detailed models to well describe the behavior of nonlinear loads. This paper develops a detailed admittance matrix model for thyristor-based converter, which is a widely used industrial non-linear load. This model can accurately describe the harmonic characteristics of thyristor-based converters, including the coupling between harmonic voltages and currents. A detailed derivation is provided, and a comprehensive evaluation of the accuracy is performed under different conditions.

P07

15:30-15:45

Research on no-communication control strategy applied to series MPPT controller
Authors: Dou Yinghua, Wang Xiao, Dong Mengxue, Dong Baolei, Liu Tao
Presenter: Dou Yinghua, State key laboratory of space power sources technology, China

Abstract: In order to maximize the power generation capacity of solar cells, the power rate transmission mode of power controller generally adopts the maximum power point tracking (MPPT) control mode. Among them, the energy system with centralized topology only contains one MPPT controller, which cannot ensure that each photovoltaic module works at its maximum power point, resulting in a significant decline in the conversion efficiency of the energy system. The architecture of distributed energy system includes parallel and series. Compared with the parallel MPPT controller, the voltage ratio of the series MPPT controller can be smaller, which is helpful to improve the conversion efficiency of the controller. Firstly, a distributed energy system based on series MPPT is proposed, and a start-up strategy without communication is proposed. Then, according to the characteristics of the proposed system, a high-precision and fast MPPT control strategy is proposed. Then, according to the system architecture and control strategy, the parameters of MPPT controller are designed. Finally, an experimental platform is built to verify the effectiveness of the proposed energy system architecture and control strategy.

P120

15:45-16:00

Improved Circulation Suppression Strategy for MMC Considering Low Frequency Oscillation
Authors: Tiehan Cheng, Jianying Zhong, Baoxin Yang, Yitao Wei, Jianyuan Xu and Zeli Zhang
Presenter: Zeli Zhang, Shenyang University of Technology, China

Abstract: When the modular multilevel converter works normally, there will be circulating currents between the bridge arms, and low-frequency oscillation circulating currents will occur under abnormal working conditions. A mathematical model of the MMC circulation is established, and the main frequencies of the circulation are derived. In order to better suppress the bridge arm circulation in the MMC, an improved circulation suppression strategy is proposed, which has a simple implementation principle and does not require phase decoupling links. The feasibility of improving the circulation suppression control strategy was verified on the RT-ALB simulation test platform. The simulation results show that the control strategy can simultaneously suppress the double-frequency circulation and the transient low-frequency oscillation circulation under abnormal conditions, and ensure the normal and stable operation of the MMC.

Shanghai Attractions

The Bund

The well-known Bund is a must for visitors to Shanghai. Fifty-two buildings lining the narrow shoreline of the Huangpu River offer a living exhibition of Gothic, Baroque, Roman, Classic Revival and Renaissance architectural styles, as well as combinations of Chinese and Western styles. They are also a condensation of the recent history of the city. The wide embankment offers ample room for strolling and is used by locals for morning exercises and evening gatherings. In the evening, colorful lights illuminate the area and create a shimmering image deserving of the name Pearl of the Orient.

The Yu Garden

The Yu Gardens are a classical landscape in the Southern Chinese style with a history of more than 400 years. Pavilions, halls, rockeries and ponds display the finest in landscaping from the Southern style as seen in the Ming and Qing dynasties. More than 40 landscapes were ingeniously separated by latticed walls, winding corridors, and lattice windows.

Shanghai Disneyland

Shanghai Disneyland, the first Disneyland theme park in mainland China, is located in Chuansha New Town, Pudong New Area, Shanghai. It officially opened on June 16, 2016. It is the second Disney theme park in China, the first in mainland China, the third in Asia and the sixth in the world.

Dr. Sun's Residence

Dr. Sun Yat-sen, the forerunner of the Chinese democratic revolution, and his wilr Soong Ching Ling, lived in this building from 1918 to 1924. It was in the residence that Dr. Sun Yat-sen met representatives of the Communist Party and fostered the first cooperation between the Chinese Communist Party and the Kuomintang.

Thank You and

See You Next Year