Special Session X

Special Session Basic Information:

专栏题目 Session Title	中文：新型电力系统下交直流故障耦合分析与保护技术 英文：AC/DC Fault Coupling Analysis and Protection Technology in New Power Systems

专栏介绍和征稿主题
Introduction and topics

中文：在“双碳”目标和能源转型持续推进的背景下，以新能源为主体的新型电力系统加快构建，电力系统呈现出高比例新能源接入、电力电子装备广泛应用、交直流深度耦合运行的发展特征。与传统同步机主导系统相比，新型电力系统的网络结构、故障特性与动态行为发生了显著变化，给继电保护与故障分析带来了新的挑战。一方面，新能源并网、电力电子化设备接入以及柔性直流输电系统的快速发展，使交流系统保护面临故障特征弱化、边界模糊、控制耦合增强等问题；另一方面，直流输电系统特别是多端柔性直流系统中，故障暂态演化快、特征窗口短、控制响应强，给直流保护原理、判据设计及工程应用提出了更高要求。同时，交直流混联系统中故障扰动传播路径复杂，交流侧与直流侧故障相互影响、相互耦合，亟需从系统层面揭示故障传播与特征演化规律，构建更加适应新型电力系统运行特征的保护理论与分析方法。本专栏面向新型电力系统领域的前沿问题，重点关注交流保护、直流保护以及交直流故障耦合分析等方向，围绕故障机理、特征提取、保护原理、控制保护协同、智能分析与工程应用等内容，交流最新研究成果，探讨关键科学问题与技术难点，推动新型电力系统保护与故障分析理论创新和工程实践发展。

征稿主题（包括但不限于）

- 高比例新能源接入下交流系统故障特性分析
- 电力电子化电网故障暂态机理与传播规律
- 新型电力系统中弱馈、弱支撑条件下故障特征演化
- 构网型/跟网型电源接入对故障行为的影响机理
- 新能源高渗透率下输电线路保护新方法
- 电力电子化系统中距离保护、电流差动保护、方向元件适应性研究
- 交流保护的自适应整定与广域协同保护
- 柔性直流输电系统故障暂态特性与机理建模
- 多端直流系统线路保护
- 直流故障快速识别、选极与测距方法
- 高阻故障、雷击扰动及复杂故障场景下直流保护技术
- 直流断路器动作配合与保护控制协同机制

英文： Under the background of the “dual-carbon” goals and the continuous advancement of energy transition, the construction of a new power system with renewable energy as the main 主体 is accelerating. Modern power systems are exhibiting development trends characterized by high penetration of renewable energy, widespread application of power electronic equipment, and deeply coupled AC/DC operation. Compared with traditional synchronous generator-dominated systems, the network structure, fault characteristics, and dynamic behaviors of new power systems have changed significantly, posing new challenges to relay protection and fault analysis. On the one hand, with the integration of renewable generation, the increasing penetration of power electronic devices, and the rapid development of flexible DC transmission systems, AC system protection is facing challenges such as weakened fault characteristics, blurred protection boundaries, and enhanced control interaction. On the other hand, in DC transmission systems, especially multi-terminal voltage source converter (VSC)-based DC systems, the fast fault transient evolution, short feature window, and strong control response impose higher requirements on DC protection principles, criterion design, and

engineering applications. Meanwhile, in AC/DC hybrid interconnected systems, fault disturbance propagation paths become more complicated, and AC-side and DC-side faults interact and couple with each other. Therefore, it is highly desirable to reveal the laws of fault propagation and feature evolution from a system-level perspective, and to develop protection theories and fault analysis methods that are better suited to the operational characteristics of new power systems. This special session focuses on frontier issues in new power systems, with particular attention to AC protection, DC protection, and AC/DC fault coupling analysis. Topics of interest include fault mechanisms, feature extraction, protection principles, protection-control coordination, intelligent analysis, and engineering applications. The session aims to provide a platform for presenting the latest research achievements, discussing key scientific problems and technical challenges, and promoting theoretical innovation and engineering practice in protection and fault analysis for new power systems.

Topics of interest include, but are not limited to:

- Fault characteristic analysis of AC systems with high penetration of renewable energy
- Transient fault mechanisms and propagation laws in power-electronics-dominated power grids
- Evolution of fault characteristics under weak infeed and weak support conditions in new power systems
- Impact mechanisms of grid-forming and grid-following power sources on fault behavior
- Novel protection methods for transmission lines under high renewable penetration
- Adaptability of distance protection, current differential protection, and directional elements in power-electronics-based systems
- Adaptive setting and wide-area coordinated protection of AC systems
- Transient fault characteristics and mechanism modeling of flexible DC transmission systems
- Line protection for multi-terminal DC systems
- Fast identification, pole selection, and fault location methods for DC faults
- DC protection technologies under high-resistance faults, lightning disturbances
- Coordination mechanisms between DC circuit breaker operation and protection-control strategies

Special Session Chair(s):

姓名 Name	雷顺广 Shunguang Lei
称谓 Prefix	Pro. 教授
部门 Department	电力工程学院 School of Electrical Engineering
单位 Organization	昆明理工大学 Kunming University of Science and Technology
城市/地区 City/Region	昆明 Kunming
邮箱 Email	leishunguang@hit.edu.cn

Organizer's Brief Biography

中文：雷顺广，博士，特聘教授，入选云南省兴滇英才支持计划“青年人才”称号，主持云南省重点项目 1 项，参与国家自然科学基金重点项目 1 项，云南省重大科技专项 1 项，以第一作者或通信作者发表中科院 1 区论文 6 篇，其中 IEEE Transactions on Industrial Electronics5 篇，Protection Control Modern Power Systems1 篇，ESI 高被引论文 1 篇（连续三次入选）。参与编写国家新兴领域规划教材 2 部，担任 Protection Control Modern Power Systems 期刊助理编辑、《电力建设》青年编委、《电力工程技术》青年编委、IEEE PES 储能技术委员会（中国）储能系统可靠性及安全性技术分委会常务理事，IEEE PES 电力系统保护控制技术委员会(中国)主设备保护技术分委会理事。

英文：Shunguang Lei is a Distinguished Professor and a recipient of the Youth Talent Program under the Yunnan Province

"Xingdian Talent Support Program." He is currently leading one key project at the provincial level in Yunnan and has participated in one key project funded by the National Natural Science Foundation of China, as well as one major science and technology project of Yunnan Province. As the first author or corresponding author, he has published six SCI papers in JCR Q1 journals, including five in *IEEE Transactions on Industrial Electronics* and one in *Protection and Control of Modern Power Systems*. One of his papers has been recognized as an ESI Highly Cited Paper for three consecutive times. He has also contributed to the compilation of two national planned textbooks in emerging fields. He currently serves as an Assistant Editor of *Protection and Control of Modern Power Systems*, a Youth Editorial Board Member of *Electric Power Construction* and *Electric Power Engineering Technology*, an Executive Council Member of the Technical Subcommittee on Reliability and Safety of Energy Storage Systems under the IEEE PES Energy Storage Technology Committee (China), and a Council Member of the Technical Subcommittee on Main Equipment Protection under the IEEE PES Power System Protection and Control Technical Committee (China).

姓名 Name	曹润彬 Runbin Cao
称谓 Prefix	Doctor
部门 Department	State Key Laboratory of HVDC Transmission Technology
单位 Organization	Electric Power Research Institute, China Southern Power Grid
城市/地区 City/Region	Guangzhou
邮箱 Email	caorb@csg.cn

Organizer's Brief Biography

中文：曹润彬，女，工学博士，正高级工程师，现任直流输电技术全国重点实验室高级研究员，南方电网领军专家，IET 皇家特许工程师，中国电机工程学会高级会员。2015 年获清华大学博士学位，主要研究方向为交直流系统故障分析、直流输电控制保护、电力电子化电网保护与控制，完成昆柳龙、三山岛等 10 项直流工程的保护专项研究，具备扎实的工程实践经验。作为负责人或技术骨干参与国家自然科学基金、科技创新 2030 重大项目、南方电网重点科技项目等 10 余项，已授权国家发明专利 20 余项，曾获中国电工技术学会科技进步一等奖等荣誉。

英文：Dr. Runbin Cao holds the position of Professor-level Senior Engineer and currently serves as a Senior Researcher at the State Key Laboratory of HVDC Technology. She is a Leading Expert at China Southern Power Grid, a Chartered Engineer with the Institution of Engineering and Technology (IET), and a Senior Member of the Chinese Society for Electrical Engineering (CSEE). She received her PhD from Tsinghua University in 2015. Her research interests centre on AC/DC system fault analysis, HVDC transmission control and protection, and protection and control of power-electronized power grids. She has led protection studies for ten HVDC projects, including Kunliulong and Sanshandao, and possesses extensive hands- on engineering experience. As principal investigator or key technical contributor, she has participated in more than ten research initiatives, among them the National Natural Science Foundation of China, the National Key R&D Program of China, and S&T initiatives projects of China Southern Power Grid. She holds over 20 granted national invention patents and has received honours such as the Science and Technology Progress Award from the China Electrotechnical Society.

姓名 Name	何佳伟
称谓 Prefix	副研究员，博士生导师
部门 Department	电气自动化与信息工程学院
单位 Organization	天津大学
城市/地区 City/Region	天津
邮箱 Email	hejiawei_tju@126.com

Organizer's Brief Biography

中文：入选中国科协“青年人才托举工程”、中国电工技术学会优博论文，以第 2 完成人获天津市科技进步特等奖、中国电工技术学会科技进步一等奖，第 3 完成人获天津市技术发明特等奖。主持国家自然科学基金 3 项（面上、青年、重点课题）、天津市科技重大专项项目 1 项、国家科技重大专项子课题 1 项。第一/通讯作者发表 SCI 论文 40 余篇，EI 期刊论文 20 余篇。出版英文专著 1 部，授权国家发明专利 20 余项。担任中国电机工程学会继电保护专委会委员、中国电工技术学会电力系统保护与控制专委会委员。

英文： Selected for the Young Elite Scientists Sponsorship Program by the China Association for Science and Technology, awarded the Excellent Doctoral Dissertation Award by the China Electrotechnical Society, the 2nd finisher received the Special Prize of Science and Technology Progress Award of Tianjin Municipality and the First Prize of Science and Technology Progress Award of the China Electrotechnical Society, while the 3rd finisher received the Special Prize for Technological Invention of Tianjin Municipality. He has led three projects funded by the National Natural Science Foundation (including General, Young Scientists, and Key Projects), one Tianjin Science and Technology Major Project, and one sub-project under the National Science and Technology Major Project. He has published over 40 SCI papers and more than 20 papers in EI journals as the first author or corresponding author. He has also published one English monograph and holds over 20 authorized national invention patents. He serves as a committee member of the Relay Protection Subcommittee of the Chinese Society for Electrical Engineering and the Power System Protection and Control Subcommittee of the China Electrotechnical Society.