IEEE Power and Energy Society
Entity Annual Report

2025

Entity: **Power System Dynamic Performance Committee**
Website:
Chair: **Yutian Liu**
Vice-Chair: **Haifeng Wang, Zhengchun Du, Xiaoming Yuan, Chen Shen, Qiang Guo**
Secretary: **Hua Ye**
Immediate Past Chair:

1. Significant Accomplishments:

To summarize, the Power System Dynamic Performance Committee and Shandong University have jointly organized a series of domestic and international exchange activities, which are chronologically presented as follows:

1) On April 21, 2025, Professor Bikash Pal from Imperial College London, a Fellow of the Royal Academy of Engineering, **IEEE PES President-Elect (2026-2027),** delivered an academic lecture themed *"Stability Modeling and Analysis of Converter-Driven Power System"* at Shandong University. Taking the recent subsynchronous oscillation instability events in the UK power system as the starting point, the lecture introduced multi-time-scale control loops and multi-time-scale dynamics of power systems, and summarized stability analysis methods for addressing the synchronization instability issues in converter-dominated grid-connected systems. Meanwhile, the lecture elaborated on an impedance model estimation method, which simplifies the modeling and analysis of power electronic devices and is applicable to power systems dominated by power electronic equipment such as Voltage Source Converters (VSC) and Modular Multilevel Converters (MMC). The rationality and effectiveness of this method were verified through frequency sweep tests via PSCAD.;
2) From June 28 to 29, 2025, the *3rd Smart Power Energy Security Forum* was successfully held in Jinan, Shandong. **The forum drew over 300 participants from diverse backgrounds and sectors**, including the Chair, Vice Chairs, Secretary-General, and members of the Technical Committee on Risk Control and Safety Assessment for New Power Systems under the Chinese Society for Electrical Engineering (CSEE); leaders of CSEE and university administrators from Shandong University; senior executives of power enterprises such as regional branches and provincial companies of State Grid Corporation of China, as well as NARI Group Corporation; experts and professors from government authorities in the energy sector, universities, and research institutes nationwide; and representatives from the power industry. All attendees engaged in in-depth discussions on the latest progress and technological frontiers in the safety planning and operation of China's energy and power systems.
3) From November 5 to 6, 2025, the *6th International Symposium on Smart Grid - Methods, Tools, and Technologies* took place in Jinan, Shandong. Focusing on engineering and technological breakthroughs as well as practical applications in the smart grid field, the symposium invited **more than a dozen renowned power experts and professors** from China, the UK, Germany, Italy, Greece, Sweden, South Korea and other countries. Attendees conducted in-depth discussions on current hot issues in power grid development. **Also in attendance were over 100 experts, faculty members and students from Shandong University**, who actively engaged in the deliberations. First launched in

2015 and held biennially, the symposium marked its 10th anniversary of successful operation this year. With a focus on cutting-edge theories, key technologies and innovative methodologies in smart grids, it has gradually evolved into an international academic hallmark for the Electrical Engineering discipline at Shandong University, effectively facilitating Chinese-foreign academic exchanges and cooperation in the smart grid.

2. <u>Benefits to Industry and PES Members from the Committee Work:</u>

1) State Grid Leadership Participation: Injecting Industrial Practical Orientation and Deepening Collaborative Foundations

The IEEE PES Power System Dynamic Performance Committee, in partnership with Shandong University and the Technical Committee on Risk Control and Safety Assessment for New Power Systems under the Chinese Society for Electrical Engineering (CSEE), co-hosted the *3rd Smart Power Energy Security Forum*. Relevant leaders from State Grid Corporation of China attended the forum and addressed key topics including industry-academia collaboration and technology deployment in new power system development. They pledged to deepen academia-industry synergy, focusing on core areas such as large power grid security and stability, renewable energy integration, and digital-intelligent upgrading for in-depth cooperation—an alignment that closely mirrors the Committee's core technical focus areas of power system dynamic stability and renewable energy grid-connection performance optimization.

2) Blackout-Specific Seminar: Targeting Prevention Challenges and Accelerating Technology-to-Engineering Conversion

During the forum, the Technical Committee, alongside State Grid Corporation of China and other institutions, hosted a parallel special seminar on the Portugal-Spain blackout incident. Gathering power industry experts and academics, the seminar delved into critical industry-specific issues, including defining safety development indicators for new power systems, coordinated planning of conventional and renewable power sources, and optimizing power grid structural strength. Building on the Committee's technical expertise in fields like multi-time-scale dynamic coupling and cascading failure prevention, the seminar explored actionable blackout mitigation solutions, driving the synergistic optimization of accident mechanism analysis and on-site power grid operation standards.

3) Industry-Centered Technical Presentations: Sharing Cutting-Edge Practices to Forge an Industry-Academia-Research Collaborative Cycle

The forum included multiple technical presentation sessions tailored to industrial requirements, covering core themes such as the safe and stable operation of high-penetration distributed photovoltaic (PV) systems, practical applications of artificial intelligence (AI) in power grid dispatching and control, demonstrations of technical equipment for power system extreme event defense, and risk control practices for new power systems. Power enterprises shared extensive engineering practices and technological R&D outcomes, further enhancing technical alignment among the IEEE PES Power System Dynamic Performance Committee, Shandong University, and China's power industry. This collaboration forged a "theory-practice-standard" collaborative cycle, delivering robust support for the safe and stable development of power systems.

3. <u>Benefits to Volunteer Participants from the Committee Work:</u>

Through the collaborative efforts of the IEEE PES Power System Dynamic Performance Committee and the School of Electrical Engineering, Shandong University, volunteer participants (including undergraduate and graduate students, as well as faculty representatives) gain comprehensive and valuable benefits across academic, professional, and personal development dimensions. These

advantages are exemplified through diverse volunteer roles in international conferences, technical seminars, and industry exchange activities:

1) Access to Cutting-Edge Academic Insights and Industry Trends

Volunteers are immersed in the latest technological advancements and strategic directions of the global power industry, enabling them to stay at the forefront of sectoral developments. For instance:During the 2025 Global Energy Internet Conference (Beijing, September 8-10, 2025), co-supported by the Committee and the School, over 20 volunteers engaged closely with nearly 1,000 guests from more than 100 countries. Undergraduate volunteers provided full-cycle conference support, while graduate students and faculty participated in parallel forums—including the "Youth Forum: Strengthening Interconnection to Promote Energy Transition"—where they gained first-hand exposure to frontier topics such as clean energy supply, global power grid interconnection, and new power system construction.Volunteers also participate in technical seminars organized by the Committee, such as the special workshop on the Portugal-Spain blackout incident and online academic exchanges on substation digitalization. These experiences allow them to delve into industry-critical issues like cascading failure prevention, power system dynamic stability, and advanced sensing technology applications, bridging the gap between academic theory and industrial practice.

2) Expansion of Professional Networks with Global Experts and Industry Leaders

The Committee's international influence and the School's academic resources create unparalleled networking opportunities for volunteers. Key interactions include:Engaging with top-tier experts such as IEEE PES officers, Royal Academy of Engineering Fellows, Chinese Academy of Engineering academicians, and senior executives from State Grid Corporation of China during international conferences. For example, volunteers at the Global Energy Internet Conference interacted with policymakers, industry leaders, and researchers, exchanging ideas on energy transition and technological innovation.Collaborating with professionals from diverse technical domains—including power system stability, renewable energy integration, and digital grid technology—through the Committee's technical working groups and thematic workshops. Such connections not only provide mentorship opportunities but also lay the groundwork for future academic cooperation and career development.

3) Enhancement of Core Competencies through Practical Engagement

Volunteer roles foster the development of transferable skills essential for academic and professional success:

Interpersonal and Cross-Cultural Communication: Undergraduate volunteers at the Global Energy Internet Conference provided bilingual support to Chinese and international guests, honing their cross-cultural communication skills while showcasing the professional demeanor of Shandong University's electrical engineering students. Volunteers also gain experience in technical interpretation and audience engagement during international seminars.

Academic Presentation and Critical Thinking: Graduate student volunteers actively contributed to panel discussions (e.g., the Youth Forum at the Global Energy Internet Conference), where they presented viewpoints on energy interconnection and received feedback from experts. Participation in incident review workshops (such as the Portugal-Spain blackout seminar) enhances their ability to analyze complex industrial problems and propose practical solutions.

Teamwork and Project Coordination: Volunteers collaborate in groups to manage conference logistics, organize technical sessions, and deliver popular science lectures—mirroring the volunteer service model of energy industry parks. For instance, in organizing academic forums, volunteers coordinate

with the Committee, the School, and industry partners, strengthening their project management and collaborative problem-solving skills.

4) Catalyst for Academic Innovation and Career Development

The hands-on experience gained through volunteer work injects new momentum into participants' research and career planning:

a) Exposure to industrial pain points (e.g., renewable energy integration challenges, grid stability risks) and cutting-edge technologies (e.g., AI-driven grid dispatching, digital substation systems) inspires research directions aligned with real-world needs. Many volunteers have integrated insights from these experiences into their thesis projects or research proposals.

b) The professional credibility and practical experience accumulated through Committee-related volunteer work enhance participants' competitiveness in academic pursuits (e.g., international exchanges, doctoral programs) and industry careers (e.g., positions at State Grid, power research institutes, or international energy organizations).

In summary, the collaboration between the IEEE PES Power System Dynamic Performance Committee and the School of Electrical Engineering, Shandong University, offers volunteers a holistic development platform that combines academic enrichment, professional networking, and skill-building. These experiences not only broaden their horizons but also equip them with the expertise and confidence to contribute to the global power industry's sustainable development.

4. Recognition of Outstanding Performance:

2025 IEEE PES Outstanding Contribution Award presented to Hua Ye, Lei Gao, WeiHu, Youbo Liu, Qiuting Guo, Qianying Mou for Leadership and Contribution to the PES Organization Development in China.

5. Coordination with Other Entities (PES Committees, CIGRE, standards, etc.):

1) On May 28, 2025, the IEEE PES Power System Dynamic Performance Committee and the School of Electrical Engineering, Shandong University hosted Mr. Wu Xuan, Secretary-General of the Global Energy Interconnection Development Cooperation Organization. The two sides reached extensive consensus on energy policy research, industry standard development, and interdisciplinary talent cultivation, which has injected fresh impetus into the sustainable development of global energy.
2) On October 30, 2025, the IEEE PES Power System Dynamic Performance Committee and the School of Electrical Engineering, Shandong University took part in the *China-Russia Energy Education and Science Symposium* themed *"Jointly Building a Sustainable Energy Future"* held in Beijing. Representatives from Shandong University delivered a report titled *"Collaborative Innovation, Talent Cultivation and International Cooperation Practices in the Field of Global Energy Internet"*, and presented prospects for Sino-Russian cooperation in joint research and talent cultivation.

6. Coordination and Involvement with Young Professionals:

1) On April 26, 2025, the School of Electrical Engineering of Shandong University successfully held the *IEEE PCCCWIP Young Researchers Forum*. The forum actively responds to and promotes the career development of female engineers in the power and energy field, and facilitates technological innovation and sustainable development in the industry.

2) On October 29, 2025, the *New Power System Sub-forum of the 10th Qilu Youth Forum* was held in Jinan, Shandong. It served as a communication platform for young talents and enhanced scientific research cooperation among outstanding young scholars at home and abroad.

7. New Technologies of Interest to the Committee:

1) Professor Yusheng Xue , Honorary President of State Grid Electric Power Research Institute, delivered a keynote speech online titled *Quantitative and Transparent Solution of Reasoning Algorithms and Multi-level Integration with AI's Rapid Prediction Capabilities.* The speech systematically expounded the approach to integrating artificial intelligence (AI) and causal reasoning research paradigms across the macro-meso-micro multi-level dimensions. Drawing on the holistic-reductionism perspective, Professor Xue proposed a research methodology for uncertain complex systems. Taking the case of risk-based potential fault ranking as an illustration, he elaborated on the two-layer framework and methodology for adaptive decision-making in stochastic complex systems. This work provides novel theoretical support for adaptive prevention and control decision-making in power grids, effectively addressing the challenges posed by complex security risks.
2) Professor Yutian Liu from the School of Electrical Engineering, Shandong University delivered a presentation titled Dynamic Security Risk Early Warning for Renewable Energy Bases and Conventional DC Systems. Focusing on the key issue of dynamic security risk early warning in the coupled operation of renewable energy bases and conventional DC systems, the presentation systematically analyzed the complex cascading fault evolution patterns of AC-DC hybrid systems under high penetration of renewable energy. It innovatively proposed a multi-time-scale hierarchical rolling early warning framework for security risks and a machine learning-based risk assessment method. Professor Liu also shared cutting-edge R&D outcomes, such as the operational risk decision support system for renewable energy power generation bases, providing crucial support for addressing the security challenges brought about by the large-scale grid integration of renewable energy.
3) Professor Qinglai Guo from the Department of Electrical Engineering, Tsinghua University delivered a presentation titled *Enhancing the Security of AI Applications in Power System Analysis and Decision-Making.* The presentation explored in depth the risks of decision-making errors arising from the application of AI technologies in power system dispatching and decision-making, as well as the corresponding mitigation strategies. It innovatively proposed leveraging generative AI technologies to improve the generalization capability of power grid AI models. Moreover, the presentation addressed the integration of physical constraints to conduct robustness verification and enhancement for neural networks. It also elaborated on the development of the GlinSAT framework, which elevates the satisfaction rate of neural networks with respect to general linear constraints and employs GRU to accelerate the solution process. This research holds significant value for advancing the in-depth application of AI technologies in power system dispatching and decision-making.
4) Mr. Shumin Sun, Chief Expert of State Grid Corporation of China, delivered a presentation titled *Exploration of the Safe and Stable Operation of High-Penetration Distributed Photovoltaics*. The presentation conducted an in-depth analysis of the power grid security challenges posed by the integration of high-penetration distributed photovoltaics (PV). Drawing on the dispatching and management experience of distributed PV in Shandong Power Grid, it elaborated on the regulation and operation modes for distributed PV systems. Mr. Sun also shared the technical approaches and demonstration applications adopted by Shandong Power Grid in multiple aspects, including distributed PV integration, power collection and step-up, hierarchical regulation, and independent grid construction. This presentation provides important solutions and practical pathways for addressing the

system security and stability issues arising from the large-scale grid integration of high-penetration distributed PV.

8. Global Involvement

1) On April 21, 2025, Professor Bikash Pal from Imperial College London, a Fellow of the Royal Academy of Engineering, **IEEE PES President-Elect (2026-2027)**, visited Shandong University to conduct technical exchanges and discussions on new power systems.
2) On September 8-10, 2025, the *2025 Global Energy Internet Conference*, titled *"Global Energy Internet: Meeting Global Electricity Demand in a Clean and Green Manner"*, was held in Beijing. The School of Electrical Engineering, Shandong University organized a volunteer team comprising undergraduate students, postgraduate students and faculty members to participate in this high-profile international conference. The team took an active part in conference services and academic exchange activities.

9. Problems and Concerns:

None.

10. Significant Plans for the Next Period:

Focusing on advancing global power system dynamic performance technology and deepening academic-industrial collaboration, the IEEE PES Power System Dynamic Performance Committee and the School of Electrical Engineering, Shandong University have formulated three key initiatives for 2026, leveraging their respective advantages in international resource integration, academic research, and local organizational capacity:

1) Assisting in Hosting the 2026 PES Day (May 2026)

The IEEE PES Power System Dynamic Performance Committee will take the lead in coordinating international academic resources, connecting global experts, scholars, and industry representatives in the field of power system dynamic performance. It will design thematic sessions around cutting-edge topics such as *"AI-driven Power System Risk Control"* and *"High-Penetration Renewable Energy Grid Integration Stability,"* ensuring the event's professional depth and international influence. Meanwhile, the School of Electrical Engineering, Shandong University will leverage its strong academic foundation and talent pool to support the organization of sub-forums, technical workshops, and young scholar exchange activities. It will also invite renowned experts from domestic universities, research institutes, and power enterprises to share localized practice cases, bridging the gap between international advanced theories and China's industrial needs. The core purpose of this initiative is to build a high-level global communication platform for power system professionals, promote the cross-border transfer and application of innovative technologies, and contribute to the sustainable development of the global energy and power industry.

2) Hosting the 4th Smart Power & Energy Security Forum (September 2026)

Building on the success of the *3rd forum* (focused on *"Digital Intelligence Drives New Power System Construction and Fortifies New Lines of Defense for Energy Security"*), the two parties will co-host the 4th session in Weihai, Shandong, with an expected attendance of 300 participants, including domestic and foreign academic leaders, industry elites, and policy makers. The IEEE PES Power System Dynamic Performance Committee will play a key role in enhancing the forum's internationalization—inviting top international experts to deliver keynote speeches, organizing cross-border panel discussions, and introducing the latest global research progress in power system dynamic

security. The School of Electrical Engineering, Shandong University will assume the main organizational responsibility, leveraging its familiarity with the Chinese power industry and local resource advantages to design agenda topics closely aligned with national energy strategies (e.g., *"Resilient Operation of New Power Systems Under Extreme Weather"* and *"Digital Twin Technology for Power Grid Security Monitoring"*). It will also coordinate on-site arrangements, academic exchange mechanisms, and achievement promotion, ensuring the forum's efficiency and effectiveness. This forum aims to deepen the scientific understanding of new power system risk management, share cutting-edge technological achievements and engineering practices, and provide actionable solutions for addressing key challenges in energy security, thereby promoting the high-quality development of China's new power system.

3) Organizing the Committee's Annual Meeting (December 2026)

The IEEE PES Power System Dynamic Performance Committee and the School of Electrical Engineering, Shandong University will jointly host the committee's annual meeting in 2026, with the School of Electrical Engineering, Shandong University providing academic and logistical support. The meeting will summarize the committee's annual research progress, technical promotion achievements, and international cooperation outcomes, while collectively formulating the next year's work plan and research priorities—with a focus on areas such as power system dynamic security early warning, AI application standardization, and interdisciplinary talent cultivation. The School of Electrical Engineering, Shandong University will leverage its academic strengths to organize special seminars, facilitating in-depth exchanges between committee members, university researchers, and industry practitioners. The annual meeting serves as a core platform for the committee to consolidate internal synergy, align international research directions with domestic industrial needs, and promote the formulation and revision of industry technical standards. It will further strengthen the committee's leading role in the global power system dynamic performance field and enhance its influence in international academic and industrial circles.

These three initiatives will fully leverage the complementary advantages of the IEEE PES Power System Dynamic Performance Committee (international resources, technical leadership) and the School of Electrical Engineering, Shandong University (academic research, local organization, industry linkage). They aim to promote the integration of global advanced technologies with China's practical needs, accelerate the translation of scientific research achievements into engineering applications, and make significant contributions to the construction of safe, efficient, and low-carbon new power systems worldwide.

Submitted by: Hua Ye
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